VEB FILMFABRIK WOLFEN

ORWO

PRESCRIPTIONS

For half a century

our factory in Wolfen, situated between the old world-trade metropolis of Leipzig and Dessau in the central industrial area of Germany has been manufacturing photographic materials and chemicals for photographic purposes. For half a century, consignements have left our factory for destinations all over the world, thus proving the popularity and utility of Wolfen products under the most varied climatic conditions. For a half-century the place-name, Wolfen, and our factory have been closely associated with technical development in photography and cinematography. Wolfen has thus become a synonym for quality and for scientific progress.

Our factory in Wolfen has, for more than 55 years, manufactured materials for every photographic and cinematographic purpose. During that time, original Wolfen products have become a by-word for quality on the world market for all those who use photographic material. They are the result of concentrated research keeping step with development and producing, by systematic scientific endeavour, a remarkably versatile range of products, including especially the world-famous original Wolfen colour film.

More than 14,000 people work in our Wolfen factories, with modern, labour-saving techniques, to satisfy the various requirements of our customers on all continents.

These world-renowned photographic products, backed by more than 55 years of tradition, are now obtainable in their well-attested quality and consistency under the new trade mark

ORWO | ORIGINAL WOLFEN

VEB FILMFABRIK WOLFEN

Contents

Contents

It may well be said that photography is largely a matter of chemistry. Not only is the manufacture of photo-materials carried out in accordance with chemical principles, but also the reactions, resulting, after exposure, in films, plates and papers in negative, positive or reversal image, are of a chemical nature.

Our photographic materials leave the factory in appropriate packings, protected against light. Our lives and environment are optically registered – by photographic equipment of the most varied kinds, for every conceivable purpose, for the amateur, the reporter, the professional photographer and the cameraman - and at first recorded as an invisible latent image. Chemical reactions of the most diverse types render the image visible, either first in the negative, which then results similarly, by printing or enlargement, in a positive; or directly, by reversal process.

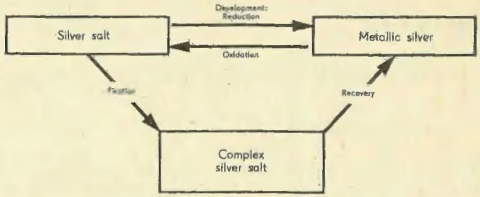
Naturally, light, as a physical process, must not be overlooked. It is always a prerequisite, prior to chemical processing, but only by this processing is the visible result finally produced. The chemical solutions which effect these transformations are discussed in the following pages. We shall now consider their expert manufacture and correct application.

ORWO

General Part

Chemical Principles

The chemical principles of photography with silver salts consist of a few transformations, the interaction of which may be characterized by the following simple formulation:



Silver salt, a general term for a group of silver compounds, which are usually soluble with difficulty only, is the carrier of the light sensitivity in photographic emulsions. A process, chemically a reduction, in photography termed development, transforms the silver salt on the exposed parts into metallic silver. By the choice of suitable reagents, we can, however, also carry out this transformation in a reversed direction, as oxidation, photographically utilized. Silver salt, furthermore, combines easily with other salts into new compounds, complex silver salts, the good solubility of which is used for fixing. This conversion is, however, irreversible. From the complex silver salt it is easy to reclaim metallic silver. Our formulation, illustrated above, shows clearly these two important interrelations, the reversible conversion silver salt – metallic silver – silver salt, and illustrates at the same time the chemical principles of photography.

The above-mentioned chemical processes become possible because of the composition of the photographic material, which, on a base, contains silver compounds which are imbedded in adhesives, in a fine and uniform distribution. The base, which may be glass, film or paper, ensures the mechanical strength of this emulsion, the adhesives of which – the gelatine – in turn safeguard the distribution of the silver compound or silver. In addition, however, the gelatine has a further important task. Its water absorption capacity permits, facilitates and controls the course of chemical reactions which are aimed at producing the various conversions required in a particular instance.

Developing and Fixing

Measures for the processing of photographic emulsions may be classified by two summarizing terms:

Developing and **Fixing**

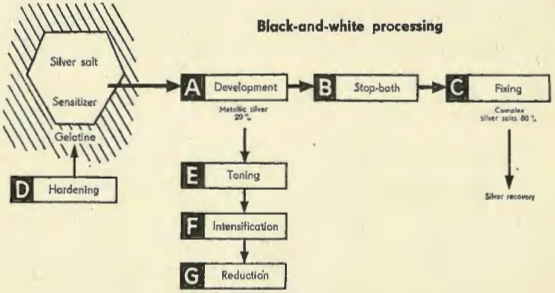
This characterizes the working processes which, after exposure, provide a visible and stable image in the photographic emulsion: Developing, regarded as the conversion of the exposed portion of the silver compound into metallic silver, which produces in the negative and positive the densities corresponding to the action of light.
Fixing, the removal of the surplus parts of the silver compound, which preserves the permanency of the photograph.
For practical purposes, it is necessary to elaborate upon the basic terms for one working process:

Developing
Stopping
Fixing
Rinsing
Drying

The important and necessary individual processes of black-and-white photography for producing negatives and positives are embodied in this sequence. The application of special processes, reversal development, toning, intensifying and reducing, may, if necessary, follow without complication. The method of producing coloured photographs is based upon this list, and need only be adapted accordingly. (see p. 131)

Schematic Diagram

Continuing our considerations of black-and-white photography, we now wish to supplement the basic method, dispensing with the required rinsing, which comprises the various well-tried methods. We start from a symbolic illustration of the photographic emulsion and pass through the treatment process, which corresponds, in its captions, at the same time, to the arrangement of the subsequently-listed instructions. In the horizontal direction, linked by thick arrowed lines, the basic treatment (A to C) is illustrated, whilst in the vertical direction, light arrows point to the ancillary treatment. We study from this the balance of the silver, and follow the conversion and interrelation, which were expressed in the formulation of the chemical processes at the beginning of this booklet.



Silver salt, usually as halide compounds (silver bromide, silver iodide, silver chloride), rendered sensitive in various wavelengths ranges by sensitizers and imbedded in the gelatine in a fine distribution, constitutes the essential component of photographic films, plates and papers. In the manufacturing process, it is adjusted to the diverse applications. Photographic emulsions, nowadays, meet the most exacting demands of science and technology, art and daily life. In the course of processing, the silver salt transforms, remaining to a small extent as a permanent image substance in our negatives and positives, the major part of it reverting, in the above-mentioned circulation, to its starting-point.

A **Developing**

The exposure has first left an invisible (latent) image. In these areas, according to the intensity of the light impression, the developer converts the silver salt, by reduction, into metallic silver, of which, on an average, not more than $^1/_5$ of the present silver salt quantity on hand is affected.

B **Stopping**

Stopping affects the silver salt only secondarily. Primarily, the developer which is still in the swollen emulsion, by changing over from the alkaline into acid range, is prevented of its capacity to have a further reducing effect.

C **Fixing**

There is an excess of silver salt. It forms, with the fixing salt, a soluble complex and disappears from the photographic emulsion.

D **Hardening**

The processing of photographic materials under inclement climating conditions or for particular technical purposes, requires greater strength. Silver salt and reduced silver remain unaffected by hardening. Only the gelatine reacts to this treatment by a reduction in its swelling capacity.

E **Toning**

The developed silver, according to the type of development, has a brownish to black colour, which may be altered by suitable toning baths.

F **Intensifying**

and

G **Reducing**

If the distribution of the brightness values does not meet the fixed requirements, it is possible by alternate application of oxidation, reduction and complex formation, to change the nature of the silver deposit, according to the requirements.

Silver Recovery

By far the major part of the silver salt, approximately 80%, passes into the fixing bath without being utilized. The recovery of the valuable silver is possible by a simple method and is recommended from an economical point of view. As a final point in our schematic diagram, it completes the series of conversions which are possible and important for processing. This however does not complete the silver circulation. By means of an industrial process, it may be re-converted into silver salt and may again be utilized in the photographic process.

The Solutions

Our schematic diagram shows the conversion by means of which the silver and its compounds may be put to use for the purposes of photography. These conversions may be achieved by a wide variety of chemical reagents of an organic and inorganic nature, which however, must, prior to application, be dissolved and concentrated as required. Water is used as a solvent or diluent, acting as a moderator between the silver salt/gelatine system and the effective chemicals. This role of the water which makes photographic solutions possible, is further extended by its property of having a swelling effect on the gelatine. To the extent to which the gelatine swells on coming into contact with the water, so the dissolved substances diffuse into the emulsion. They, thus, have an opportunity of reaching the finely-distributed silver halide or silver particles, surrounded by the gelatine, and thus to develop their efficiency. By their diffusion, the soluble conversion products are completely removed after the reaction, and finally (by rinsing) the surplus portions of the solution. The gelatine already plays a part during the manufacture of the photographic emulsion, due to its influence on the properties of the silver halide. During processing, it has the task of slowing down the access of the solution to the silver halide or silver particles, and thus to control the speed of reaction.

Before using the solutions they must be prepared, and upon concluding these general considerations, we shall give this our closer attention. We proceed from the assumption that the user of this brochure knows the photographic processes and that he is acquainted with the application and method of operation of the solution, so that we need deal here only with the preparation, the properties and the treatment of these solutions, during both storage and use.

Self-preparation or Ready-for-use pack

The variety of photographic films, plates and papers corresponds to the variety of tasks in photography. In order to master all these special problems, the appropriate photographic materials must be resorted to, and the specified working procedure followed. The VEB Filmfabrik Wolfen today manufacture materials for every purpose and also issue the necessary instructions for use in order to ensure optimum results.
Prior to beginning the processing of photographic emulsions, one question must be decided, namely, the important problem of preparing the processing solutions: Composition of this solution from the various materials by self-preparation, according to the known formulae, or the application of ready-to-use packs? The answer to this question depends on the working conditions laid down and on the personal attitude of the user.

Ready-for-use Pack

The application of ready-for-use packs provides the especial advantages of safety and comfort. The requisite quantities of materials, of well-proven quality, have already been measured in the correct proportions. Only a little technical effort is required and this is limited to the provision of a few containers for dissolving and keeping the solution and to the possibility of measuring out the necessary water and heating it. The ready-for-use pack eliminates errors due to unsuitable chemicals, the mistaking of chemicals or the use of wrong quantities. Furthermore industrial mixtures sometimes contain special additives, to obtain special effects; these admixtures are usually protected by patents and are obtainable through the trade only with difficulty. However, ready-for-use packs are not available for all photographic solutions. They are limited to the most important processes. There is a large selection of ready-for-use packs for development and fixing with regard to both type and quantity.

Self-preparation

Whoever wishes to prepare solutions himself, undertakes a greater measure of responsibility and work. The advantages, which we mentioned for ready-for-use packs, do not longer apply. Ease becomes effort, certainty is reduced, the time involved and the technical prerequisites increase. We must obtain the chemicals, test them, store them, compound them according to a formula, weigh them and dissolve them.

Each process has an inherent possibility of errors; these will become apparent only during use. Self-preparation, on the other hand, also has advantages. The selection of volume is not limited to fixed quantities, as in the ready-for-use packs. There is a possibility of modifying the instructions in the formula according to one's own experience. Economic considerations may also tend to make self-preparation advisable.

Both methods lead to the same goal, but with both the methods, suitable solutions are obtained only with a suitable type of water.

Water

The mediating part played by water in photography has already been discussed. In most instances nowadays water is taken from the tap; only in rare occasions from the well. Its composition varies in different places, according to geological conditions. Purification at the waterworks imparts to the water a physiologically perfect quality, but there always remain substances, which, from the photographic point of view, may be regarded as aberrative components. Air in the water as a result of its oxygen content, may cause oxydation of the developer substance. Calcium and magnesium salts result in turbid precipitations. The ready-prepared packs contain so called water softening chemicals, which prevent these precipitations.

Distilled Water?

Equally, no quality deterioration occurs when using distilled water for the preparation of solutions in accordance with the formulae. It is, however, only essential to use it in a few cases. Where this is the case, special attention is drawn thereto in the instructions.

Water of sufficient photographic purity may be prepared by boiling, whereby air and also the disturbing lime salts are removed. Turbidity-free solutions are also obtained by using ORWO Anti-Lime Agent **A 901** (see page 121). Floating particles from the main may be retained by filters.

Composition of Solutions

A comparative observation of formulae shows that, for the various groups of processing (developing, fixing . . .), a certain system may be laid down. We find with this analysis of the formula structure the principal and ancillary components in photographic solutions. All instructions for use contain one or several chemical substances characterizing the formula in its properties. A special effect by additional components is then given to the solution.

Effect of Chemicals

For fixing baths, for instance, sodium thiosulphate is the basic substance, which by itself exercises an effect corresponding to the prescription of the bath. Sulfurous acid salts increase the life of the fixing bath. Ammonium chloride promotes fixing speed. Alum gives the bath a hardening capacity.

The action of bleaching baths in indirect toning is imparted by potassium ferrocyanide (III). Further chemicals may be added, which already during bleaching influence the subsequent tone.

Several substances are essential in developers. The composition of the normal developer shows, in addition to developer substance, further three components, the interaction of which produces the required characteristic of the emulsions to be developed:

Developer Substance

Accelerator-Retarder-Protective Substance

Developer substance is a generic term for a number of organic chemical substances of specific composition, which transform the exposed silver halides into metallic silver.

Pyrocatechin	
Hydroquinone	ORWO **H 142**
Hydroxydiaminobenzene	ORWO **A 140**
Monomethyl-p-aminophenol	ORWO **M 143**
Para-Hydroxyphenyglycin	ORWO **G 141**
Paraminophenol	
Paraphenylenediamine	
Pyrogallol	

Of the chemical substances having developing properties ORWO **M 143** and ORWO **H 142** are those primarily used in practice.

Accelerator: a group of inorganic substances covered by the name of alkali, which impart the above reaction to the developer substance and accelerate the course of the reaction.

The efficiency of a developer is determinded by the alkali used, the selection and concentration of which depends on the purpose for which the developer is used. The caustic alkalis range from carbonates to alkalis with a weak action.

Caustic alkalis .....Sodium hydroxide, potassium hydroxide
Carbonate alkalis.....Potassium carbonate (Potash), Sodium Carbonate (soda)
Subdued alkalis .....Sodium tetraborate (borax)

Retarders control the reaction in the opposite direction with the influence limited rather to the unexposed silver halide particles i. e. to retain fog.

The role of a retarder in developers is assumed by the potassium bromide. It curtails the course of development and protects the unexposed silver halide against the effect of the developer.

Protective Substance: is used to avoid the effect of the atmospheric oxygen on the developer substances. which may easily oxidize. The developer substances are protected against the air by adding sulphites in the form of sodium sulphite or neutralized hydrogen sulphite. They prevent rapid oxidation of the developer.

In addition to these basic substances, further chemicals may be added to the developer to obtain special effects (hardening of the layer, size and colour of the silver grains).

The various substances which may be contained in the developer have been purposely enumerated in order to indicate the variety of developer formulae. The versatility of their action corresponds to the large number of possible developers. This versatility permits the control, in the photographic emulsion, of the conversion of silver halide into metallic silver in such a manner that the different silver particles in each instance ensure the best utilization of speed, maximum contrast, the most delicate gradation and the finest grain.

Chemicals

The chemicals which we require for the preparation of the solutions are listed in a table (pages 168 to 175) in accordance with the subsequently-mentioned formulae. This assists us to see at a glance the designation, properties and application of the substances. In the first column the usual names of the chemicals and the formulae are listed. The second column includes a list of other descriptions of the same substance. There follow appearance and properties, and, in the last column, the application of the particular formulae.

Handling of Chemicals

The handling of chemicals requires care. Storage should always be effected in well-closed containers: in bottles, tins or drums, corresponding to the quantity and the behaviour of the substance. They should be marked clearly, so that any error is obviated. The type of storage must ensure that the chemical quality remains unchanged. Absorption of water, evaporation, weathering, change in concentrations, generation of noxious gases, (note the influence on light-sensitive materials), and light-effects may all occur under unfavourable storage conditions and have a deleterious effect on the chemicals. Some substances are poisonous and must, therefore, be stored separately; others are caustic, such as, for instance, alkalis with their skin-irritating action. ORWO **M 143** affects only those people with a particularly high sensitivity. Irritation of the skin may result even in the onset of eczema and force that particular person to give up his job.

Consistency of Chemicals

When acquiring photographic chemicals, one has to ensure their suitability for the requisite purpose. The substances should be clean and free from frequently-occurring impurities in the technical quality. It is also recommended to obtain the finest crystalline or ground material possible. The better dissolving capacity facilitates and accelerates work. It is important to know the water content. Between the crystalline and the anhydrous* product there are major differences in weight, which must be taken into consideration in compiling the formula, and when preparing the solution.

* We have dispensed with the definition "accum" for anhydrous as it is not uniformly used in trade literature.

The following list contains some of the frequently used salts:

	crystalline	anhydrous
Sodium Carbonate	100	37
	270	100
Sodium Sulphite	100	50
	200	100
Sodium Thiosulphate	100	64
	157	100
Sodium Sulphate	100	44
	227	100

Technical Remarks

The preparation of photographic solutions from ready-for-use packs should not cause any difficulties if the instructions are observed. For preparation, however, some further advice is necessary.

Water, Chemicals, Apparatus

Water and pure chemicals are the basic requirements. Not less important are scales and a measuring cylinder; containers for dissolving and storage, stirring rods, funnels, filters and thermometers. The consistency and type of the technical requirements depend on the volume of work. It is not possible to prepare tank liquids in beakers. Buckets are not suitable for quantities of 1 litre only. The type of material used for containers depends, on the one hand, on the volume of work; on the other, on the properties of the solution. Glass, pottery, earthenware, laminated substances and plastic, and stainless steel are used for dishes, troughs and tanks. Stainless steel is not resistant to corrosion from all processing solutions. Glazed containers must also be used with caution. Cracks and fine scratches in the glazing are sometimes the cause of unsatisfactory results.

Preparation

In the preparation of solutions from formulae, the rule to be applied is to add only one substance at a time; to dissolve it completely, and, only then, to add the next component. For developers, the protective substance should be dissolved first and subsequently the developer substance. ORWO **M 143** does not follow this rule because it is soluble with greater difficulty in a more concentrated sulphite solution. In this instance, a small quantity of sulphite is first placed into the water, and subsequently the ORWO **M 143**, then the main quantity of sulphite, hydroquinone (ORWO **H 142**) and the further components only after the previous ones have been dissolved. To prepare, one commences with $^4/_5$ths of the specified quantity of water, topping up afterwards to the full volume. Earlier formulae were based on quantities of 1 litre, so that the finished photographic solution had varying volumes and contents which could be determined only with difficulty. The new type of preparation is independent of the water content of the salt (crystalline or anhydrous) and clearly stipulates the contents of solid substance.

Dissolving Technique

Any stirring required should be carried out carefully without violent motion or formation of froth. Small bottles frequently tempt one to shake vigorously, a measure which is especially unfavourable to developers. Slight tilting to and fro is more advisable.

The higher the temperature, the quicker the dissolution. The starting water temperature for developers is 30 ° to 45 °C. Where caustic alkalis, which dissolve while generating much heat are to be used, the initial temperature must be kept lower. Sodium thiosulphate, as a crystalline salt, dissolves, however, while cooling down a great deal, so that its dissolution may be promoted in water at 60 ° to 70 °C. The solutions must be allowed to cool down before adding the acidifying and hardening salts.

With sodium thiosulphate, rapid dissolution may be achieved according to the principle of the dissolving sac, prior heating of the water not being required. This principle may also be applied in other instances and is recommended especially with coarsely crystalline components. It dispenses with the effort of reducing and applying a mortar. The salts are placed in sacs or plastic screens, which emerge slightly below the liquid level. The solution sinks downwards in dense striations, it displaces the water or the lighter components of the solution upwards, these being then enriched further with substance. This circulation stops only after the salts are completely dissolved. Effortlessly, without stirring, the solution has been prepared and is free from coarser impurities.

The preparation of photographic processing solutions is for preference best carried out a day prior to use. The method has the following advantages:

1. An internal compensating balance sets in as the solution settles down. The oxygen of the enclosed air exercises his oxidation capacity and is used up.
2. Turbidities change into flocculations or precipitations. The main part of the solution may then easily be poured away from the deposit on the bottom and the remainder quickly filtered.
3. Temperature differences disappear, the solutions adapt themselves to room temperature.

Thus without great effort one obtains processing solutions safely and uniformly. The preparation of the solutions should not, if possible, be carried out in the darkroom in order to eliminate damage to the photographic material caused by dust. If the chemicals spray during weighing as a result of dried up filters or spilt solutions, the result of the photographic work may be questionable.
After preparation, the solutions are put in containers for work or storage for subsequent use. The type and date must be clearly marked to ensure orderly, well-planned and organized work.

Maintenance of Apparatus

The apparatus should, if possible, be cleaned immediately after use, often just rinsing with water and mechanical cleaning by brush and cloth are sufficient. For coating, which is removable only with difficulty, various auxiliary maens may be used, such as acids and oxidising salts.

1. Hydrochloric acid:

   Concentrated hydrochloric acid should be diluted 5 to 10 times. After use rinse thoroughly with water.

2. Bichromate – Sulphuric acid:

   Dissolve 50 gr potassium bichromate in 1 litre of water and carefully add 100 ml. of concentrated sulphuric acid in small proportions, whilst stirring thoroughly. After use rinse well with water.

3. Potassium.permanaganate-sulphuric acid:

   After dissolving 20 gr of potassium permanganate in 20 litres of water, 20 ml of concentrated sulphuric acid is carefully added. The apparatus treated is subsequently rinsed with sodium or potassium hydrogen sulphite solution of 5% to 10% and then with water.

Special attention should be drawn to the dangers of using strong acid. In particular, aqueous solution must never be added to concentrated sulphuric acid. The sulphuric acid must always be carefully added in small proportions to the specified quantities of aqueous solution.

Working Protection

To avoid physical harm when using chemical substances, the official regulations which specify the use of protective equipment, (goggles, rubber gloves, respirators, gas masks, etc.) should be strictly observed.

III Application of Solutions

Dish – Box – Tank – Machine

These four terms outline the typical technical methods for processing photographic emulsions:

The **Developing Dish** is the classical apparatus for processing plate, cut film and paper individually or in quantity;

the **Developing Box,** suitable for individual roll – and miniature films;

the **Developing Tank** for mass-processing of films and plates;

the **Developing Machine** for the uniform processing of larger quantities of film and paper.

The change-over in the course of time, from individual processing of negative materials to an automatic method, has expressed itself in the apparatus. Instead of personal control, in the negative development, which was formerly required, due to the small choice in positive, rigid development according to time has become accepted. With modern films and plates, the increased light and colour sensitivity in general make personal observation of the development process impossible. Developing box and developing tank have largely displaced the developer dish in negative processing. Its application is mainly in positive processing, reproduction techniques and special treatments.

The result of development depends largely on the agitation of the developer. The final point will be reached sooner when the exchange between exhausted and fresh developer is effected more quickly. In the dish, there is a swinging agitation in the horizontal position, of the material to be developed. In the box the emulsion occupies a horizontal or vertical position, according to the design of the box with a circular agitation, and in the tank the films are suspended vertically with a slight agitation. According to these conditions, the developing times change. For dish and box they are approximately the same, for the tank they are somewhat longer. The times required for plates and films in some of the most usual developers, are listed later. (see pages 77 to 86).

Illumination of the darkroom must depend on the light sensitivity of the material. To facilitate working, a corresponding protective filter may be used. See the tables at the end of this booklet: pages 178 to 183.

Clean Work – Correct Temperature – Correct Time

Cleanliness is the first rule. When discussing the preparation of solutions, the danger which could result from sprayed chemicals has already been mentioned. The result of this is: contaminated baths, discoloured, spotty emulsions and, therefore, waste of material. Contamination of baths may, however, also occur from one solution getting into another. Dirty fingers, splashes of solutions, insufficient washing of the emulsion between the various treatments, introduce into the various baths components which do not belong in the solution. These result in reduced yield of the bath and in an impaired life of the material treated.

The normal temperature in photography is 20 °C. All instructions for processing refer to this temperature, unless other values are mentioned. Although deviations in both directions are possible, the use of lower temperatures sometimes has disadvantages. Thus, for instance, hydroquinone (ORWO **H 142**) already works sluggishly at 16 ° to 17 °C. Checks should, however, always be made with a thermometer to obtain information for subsequent work. Unknown and fluctuating temperatures complicate the work.

What applies to the temperature, applies also to time. It is difficult to estimate time. Only the use of a watch provides certainty. With complicated processes, such as in reversal development, with a repeated change in the processing baths and washing, the use of a watch is indispensible.

Life – Utilization – Regeneration – Checking

Photographic solutions may be concentrated storage solutions, or solutions of normal concentration, sometimes also in different parts. The instructions for use give information on dilution with water and mixing parts of solutions. In the formula part **individual solutions,** which should be **combined into a mixture,** have been described, in the case of developers, as **Solution A** and **Solution B** ... for all other baths as **Solution 1** and **Solution 2.** If the formula contains however, the indication **Solution I, Solution II** ... the **unmixed** solutions must be used **individually** and **one after the other.**

Life

The solutions have only a limited life. It is recommended to keep them in a closed bottle filled up to the brim, protected as far as possible against light. This measure applies especially to developers. They are sensitive to air and light. Started bottles always show a reduced life. The storage of used solutions is subject to the same precautionary measures. These should never be left standing open in dishes. Oxidation and evaporation would soon render the baths useless.

If it is not possible to put the solutions into bottles, as for instance in the case of tanks, they must be protected from detrimental effects when not in use by covering them. It is always a sure hazard to use solutions again after an extended period. It is not always possible to conclude that the solutions are useless, because they are dark-coloured or turbid. In such instances, the degree of efficiency should be tested. Where processing is carried out only seldom, a fresh preparation is always the safest method.

Utilization

The procedure from the exposed photographic material to the dried negative or positive leads through various processing baths, with intermediate and final rinsing. The dry emulsion swells in the developer. The reaction commences. By diffusion, the conversion products are removed and proportions of fresh solutions brought to the silver halide. When at the end of development the emulsion is put into the subsequent bath, a changed developer is left behind; reduced in developing power, and reduced in overall volume. Every further development causes a change in the same direction: exhaustion of developer substance and reduction in liquid quantity. The emulsion arrives at the subsequent bath in a swollen condition and dilutes the solution with its water content. An exhaustion of liquid cannot, however, occur, if one disregards slight modifications of the swelling areas of the gelatine, due to the change between water and processing solution or the processing solutions themselves, as the initial volume is again achieved when removing the emulsion. The contents of chemical changes, however, as with the developer, in the ratio of conversion, and through carried out components of the solution.

With a developer, therefore, to a certain extent we recognize the degree of utilization in the decrease of the volume. The exhaustion of a developer is furthermore recognized by its reduction in efficiency. The reaching of certain densities requires a longer time. In the case of excessive use, an extension of time does not help much. There result weak gradations. The exhaustion of a fixing bath cannot be observed in this manner. It is possible to determine the fixing speed of fresh and used solutions, but this does not give an indication of the enrichment of the fixing bath with silver. This silver content is decisive for the stability of negatives and positives. The less the fixing bath is used, the better the life of negative and print. The silver content of the fixing bath should not exceed 2 to 3 gr per litre in the positive process. With a negative fixing bath the utilization may be increased to 4 to 5 gr silver per litre. These quantities of silver are present in 200 to 300 sheets of photographic paper of size 9/12 cm (2 to 3 m^2), 100 plates 9/12 cm or 15 to 20 roll- or miniature films. Special attention is drawn to the fact that it is necessary for the stability of the prints to use separate fixing baths for negative and positive processing.

Regeneration

The demand for uniform results will not be fulfilled satisfactorily by baths, the efficiency of which are continually reduced. Identical working results can only be achieved with a continuous regeneration of the developer and a frequent change of the stop and fixing bath. In regenerator packs, which represent the results of practical observation and analytical examination, we have means of keeping the working level of the developer stable. The composition of these replenishers takes the above-mentioned conversions into consideration. Exhausted substance, the developer substances, the alkali, are added preferentially; potassium bromide generated during the development, is not added at all, or only in small quantities. Regenerator packs are, therefore, not suitable for preparing a fresh developer. On the other hand, they replenish also only those developers of the same designation, which were in normal use. Losses of developer due to leaky tanks or bad fasteners cannot, therefore, be compensated.

Inspection

In larger work, with continuous processing of photographic materials, the baths are continually inspected. According to the results of analysis, the working capacity of the baths is maintained at the highest possible level by replenishing with regenerator solution. There are various methods of inspection, however, which are only worthwhile in the case of large-scale work, and presume some chemical and analytical experience. Recently, the determination of the hydrogen ion concentration (p_H-value) which can be carried out without large apparatus has been applied. The characterization of various solutions (developer/alkaline, water/neutral, stop baths, fixing baths/acid) is carried out simply with P_H indication papers.

The above remarks could only give a brief survey of this wide field and serve only as an introduction to the formulae. The trade literature must be resoted to for individual problems of a technical and scientific nature. Information can be obtained from journals, leaflets, handbooks and text books, which are continually in publication and give advice and replies to many questions. In case of doubt, we shall be pleased to give you any information you require.

Please contact the **"Technischen Aussendienst Foto"** of:

VEB Filmfabrik Wolfen

444 Wolfen 1

German Democratic Republic

ORWO

Formulae and Instructions for Use

A1 | ORWO Developer Formulae

With the following instructions for photographic processing solutions, it should be noted that the **weight of constituents** of the formulae apply to a **final volume of one litre,** unless otherwise stated. Before adding the developer components, approx. 2 g. of ORWO Anti-Lime Agent **A 901** (see page 121) should be added to the water to obtain turbidity-free solutions.

All weigth datas set out for sodium sulphite, sodium carbonate and sodium sulphate, refers to the anhydrous salt. For conversion to crystalline material, use the list on page 20.

Specifications of the duration of **development at 20 °C,** as far as no other temperature is given, and notes on the gradation of the photographic silver image obtainable, are contained in the last column of the list.

The developer formulae are listed in the sequence in which they are numbered. The first column of the tables gives information on the application of the individual developers for various purposes. The symbols used are explained in the following list, and the developers relating to each group are set out.

Code		ORWO Formula-No.
Neg	= General Negative Developer	= 1, 12, 14, 16, 40, 41, 46, 47, 72
FK	= Fine-grain Compensation Developer	= 12, 14, 16, 44
Kin	= Cine-Film Machine Developer	= 12, 14, 15, 16, 18, 20, 22
Rtg	= X-ray Developer	= 30, 31, 35
PA	= Portrait- and Amateur's Developer	= 8, 10, 40, 41, 42, 44, 45, 46, 47, 60, 61, 62, 72
Trop	= Tropical Developer	= 16, 31, 35
Repro	= Reproduction Developer	= 70b, 71, 72, 73, 75, 76, 80, 81, 82
Pos	= Paper Developer	= 20, 47, 72, 100, 105, 108, 115, 120, 122, 123, 124, 125, 126, 130, 131
Spez	= Special Developer	= 22, 50, 78, 79, 108, 110, 111, 115, 130, 131, 135
S	= Rapid Developer	= 18, 35, 36, 70b
Dia	= Developer for Transparency Material	= 1, 71

The application of developers should by no means be strictly fixed within this classification of developing instructions. The classification essentially fulfils the purpose of facilitating the selection of suitable instructions for the use of developers for the various processes.
The following list is arranged in accordance with the components of the developers.

Developer Component	ORWO Formula-No.
Pyrocatechin	= 35, 78, 79
ORWO H 142 (Hydroquinone)	
with potassium carbonate	= 120, 123, 126
with tri-potassium phosphate	= 75
with potassium hydroxide	= 70b, 110, 111
with paraformaldehyde	= 82
ORWO A 140 (1-hydroxy-2,4-diaminobenzene hydrochloride)	= 47
ORWO M 143 (Monomethyl-p-aminophenol sulphate)	
with sodium sulphite	= 55
with sodium carbonate	= 12, 14, 15, 16, 76
with potassium carbonate	= 18, 105
ORWO M 143 – ORWO H 142	
with sodium tetraborate	= 19, 44
with sodium carbonate	= 20, 22, 30, 31, 42, 45, 46, 61, 73, 81, 100, 115, 124, 125, 130, 131, 135
with potassium carbonate	= 1, 40, 50, 71, 74, 80, 108
with sodium hydroxide	= 36
ORWO G 141 (para-hydroxyphenyl glycin)	= 8, 72, 122
Paraminophenol	= 10
Pyrogallol	= 41, 60, 62

Developers for Black-and-White Films and Plates

	Designation	Formula		Duration and Character of Developer
	ORWO 1			
Neg Dia	Strong Negative Developer (= ORWO 108)	ORWO M 143 ..... Sodium sulphite ..... ORWO H 142 ..... Potassium carbonate ..... Potassium bromide	5 g. 40 g. 6 g. 40 g. 2 g.	3 to 4 minutes Rapid and very strong
	ORWO 8			
PA	Compensating Portrait Developer	Sodium sulphite ..... ORWO G 141 ..... Potassium carbonate	12.5 g. 2 g. 25 g.	8 to 10 minutes soft
	ORWO 10			
PA	Standard Portrait Developer	Solution A: Paraminophenol hydrochloric ..... make up to 1 litre Solution B: Sodium sulphite ..... Potassium carbonate ..... make up to 2 litres for use mix 1 part A and 2 parts B	20 g. 150 g. 120 g.	 10 to 12 minutes normal
	ORWO 12			
Neg FK Kin	Fine-grain Developer	ORWO M 143 ..... Sodium sulphite ..... Sodium carbonate ..... Potassium bromide	8 g. 125 g. 6 g. 2.5 g.	10 to 12 minutes soft
	ORWO 14			
Neg FK Kin	Fine-grain Developer	ORWO M 143 ..... Sodium sulphite ..... Sodium carbonate ..... Potassium bromide	4.5 g. 85 g. 1 g. 0.5 g.	12 to 15 minutes soft
	ORWO 15			
Kin	Cine-negative Machine Developer	ORWO M 143 ..... Sodium sulphite ..... Sodium carbonate ..... Potassium bromide	8 g. 125 g. 12 g. 1.5 g.	7 to 9 minutes soft and fine-grain

	Designation	Formula			Duration and Character Developer
	ORWO 16				
Neg Fk Kin Trop	Tropical Developer	ORWO M 143 ..... Sodium sulphite ..... Sodium carbonate ..... Potassium bromide ..... Sodium sulphate*	6 100 12 3 40	g. g. g. g. g.	8 to 10 minutes at 20 °C 3 to 6 minutes at 24 to 28 °C soft and fine-grained
	ORWO 18				
Kin S	Cine-negative Rapid Developer	ORWO M 143 ..... Sodium sulphite ..... Potassium carbonate ..... Potassium bromide	15 75 50 1	g. g. g. g.	1 minute soft
	ORWO 19				
Neg Kin	Cine-negative Machine Developer	ORWO M 143 ..... Sodium sulphite ..... ORWO H 142 ..... Sodium tetraborate	2 100 5 2	g. g. g. g.	10 to 12 minutes soft and fine-grained
	ORWO 19 R				
	Regenerator for ORWO 19	ORWO M 143 ..... Sodium sulphite ..... ORWO H 142 ..... Sodium tetraborate	2.5 100 6 12	g. g. g. g.	
	ORWO 20				
Kin Pos	Positive Cine Developer	ORWO M 143 ..... Sodium sulphite ..... ORWO H 142 ..... Sodium carbonate ..... Potassium bromide	2 25 4 18.5 2	g. g. g. g. g.	3½ minutes strong 1 to 2 minutes for photographic paper
	ORWO 20 R/2				
	Regenerator for ORWO 20	ORWO M 143 ..... Sodium sulphite ..... ORWO H 142 ..... Sodium carbonate	2.5 30 6.5 30	g. g. g. g.	
	ORWO 22				
Kin Spez	Cine-title Developer	ORWO M 143 ..... Sodium sulphite ..... ORWO H 142 ..... Potassium carbonate ..... Potassium bromide	0.8 40 8 50 5	g. g. g. g. g.	4 to 5 minutes very hard

* add in small quantities

	Designation	Formula			Duration and Character of Development
	ORWO 30				
Rtg	X-ray Developer (= ORWO 135)	ORWO M 143 ..... Sodium sulphite ..... ORWO H 142 ..... Sodium carbonate ..... Potassium bromide	3.5 60 9 40 3.5	g. g. g. g. g.	5 to 6 minutes rapid and strong
	ORWO 31				
Rtg Trop	Tropical X-ray Developer	ORWO M 143 ..... Sodium sulphite ..... ORWO H 142 ..... Sodium carbonate ..... Potassium bromide ..... Sodium sulphate*	3.5 60 9 40 5 100	g. g. g. g. g. g.	2 to 3 minutes at 30 °C 3 to 4 minutes at 28 °C 4 to 5 minutes at 26 °C strong
	ORWO 35				
RTg S	Rapid X-ray Developer	Solution A: Sodium sulphite ..... Pyrocatechin ..... made up to 1 litre	100 100	g. g.	
		Solution B: Sodium hydroxide ..... Potassium bromide ..... made up to one litre.	60 100	g. g.	40 to 60 seconds strong
		Immediately prior to use mix one part A with one part B. The developer has a stability of a few hours only. It is, however, also possible to carry out developing direct in the considerably more stable stock solutions. The film is placed at first into			
		Solution A: subsequently without rinsing into			30 seconds
		Solution B:			30 seconds strong
	ORWO 36				
S	Rapid Developer	Solution A: ORWO M 143 ..... Sodium sulphite ..... ORWO H 142 ..... Potassium bromide ..... make up to 800 ml	5 40 6 1.5	g. g. g. g.	
		Solution B: Sodium hydroxide ..... make up to 200 ml	16	g.	
		shortly before use mix 4 parts A and 1 part B			25 to 45 seconds normal

* add in small proportions

	Designation	Formula	Duration and Character of Development
	ORWO 40		
Neg PA	Strong Negative Developer	ORWO M 143 ..... 1.5 g. Sodium sulphite ..... 18 g. ORWO H 142 ..... 2.5 g. Potassium carbonate ..... 18 g. Potassium bromide ..... 1 g.	4 to 5 minutes strong
	ORWO 41		
Neg PA	Pyro Developer	Solution A: Citric acid ..... 4 g. Pyrogallol ..... 28 g. Sodium sulphite ..... 100 g. make up to 1 litre Solution B: Sodium carbonate ..... 40 g. make up to 1 litre For use mix 1 part A and 1 part B with 2 parts of water	4 minutes normal
	ORWO 42		
PA	Tank Developer	ORWO M 143 ..... 0.8 g. Potassium bisulphite ..... 4 g. Sodium sulphite ..... 45 g. ORWO H 142 ..... 1.2 g. Sodium carbonate ..... 8 g. Potassium bromide ..... 1 g.	8 to 10 minutes normal
	ORWO 44		
FK PA	Borax Fine-Grain Tank Developer	ORWO M 143 ..... 1.5 g. Sodium sulphite ..... 80 g. ORWO H 142 ..... 3 g. Sodium tetraborate ..... 3 g. Potassium bromide ..... 0.5 g.	15 to 18 minutes soft and fine-grained
	ORWO 45		
PA	Tank Developer	ORWO M 143 ..... 1 g. Sodium sulphite ..... 13 g. ORWO H 142 ..... 1.8 g. Sodium carbonate ..... 4.5 g. Potassium bromide ..... 0.6 g.	8 to 10 minutes normal

	Designation	Formula	Duration and Character of Development
	ORWO 46		
Neg PA	Tank Developer	ORWO M 143 ..... 1.1 g. Potassium bisulphite ..... 0.4 g. ORWO H 142 ..... 1.6 g. Sodium sulphite ..... 21.5 g. Sodium carbonate ..... 6 g. Potassium bromide ..... 0.4 g.	7 to 9 minutes normal
	ORWO 47		
Neg PA Pos	Multi-purpose Developer	Sodium sulphite ..... 100 g. ORWO A 140 ..... 20 g. For use for negative development mix 1 part developer with 3 parts of water. For use for paper development 1 part developer with 1 part water. To reduce the tendency to fogging add 1 gr of potassium bromide to 1 litre of this mixture	5 minutes normal 1 to 2 minutes
	ORWO 50		
Spez	Tank Developer for Document Films	ORWO M 143 ..... 1.8 g. Sodium sulphite ..... 75 g. ORWO H 142 ..... 4.5 g. Potassium carbonate ..... 37.5 g. Potassium bromide ..... 4.5 g.	4 to 5 minutes strong
	ORWO 55		
Trop	Tropical Tank Developer	ORWO M 143 ..... 15 g. Sodium sulphite ..... 75 g. Potassium bromide ..... 2 g. Sodium sulphate* ..... 50 g.	10 to 12 minutes at 30 °C strong 20 minutes at 25 °C 30 minutes at 20 °C normal
	ORWO 60		
PA	Pyro Developer	Solution A: Potassium bisulphite ..... 50 g. Pyrogallol ..... 50 g. Sodium sulphite ..... 130 g. make up to 1 litre Solution B: Sodium carbonate ..... 85 g. make up to 1 litre For use mix 1 part A and one part B with 4 parts of water	7 to 9 minutes soft

* add in small portions

	Designation	Formula	Duration and Character of Development
	ORWO 61		
PA	Portrait Developer	ORWO M 143 ..... 3.5 g. Sodium sulphite ..... 50 g. ORWO H 142 ..... 6,5 g. Sodium carbonate ..... 40 g. Potassium bromide ..... 1 g. for use mix 1 part of developer with 3 parts of water	5 to 6 minutes standard
	ORWO 62		
PA	Pyro Developer	Solution A: Potassium bisulphite ..... 5 g. Pyrogallol ..... 30 g. Potassium bromide ..... 1 g. make up to 500 ml Solution B: Sodium sulphite ..... 100 g. make up to 500 ml Solution C: Sodium carbonate ..... 40.7 g. make up to 500 ml For use mix 50 ml each of solutions A, B and C and make up to 1 litre	10 minutes soft
	ORWO 70b		
Repr S	Caustic/alkaline Reproduction Developer	Solution A: Potassium bisulphite ..... 25 g. ORWO H 142 ..... 25 g. potassium bromide ..... 25 g. make up to one litre Solution B: Potassium hydroxide..... 50 g. make up to 1 litre For use mix shortly beforehand the equal parts of A and B	2 to 3 minutes hard 30 to 40 seconds as rapid developer for standard photographic material
	ORWO 71		
Repr Dia	Strong Reproduction Developer	ORWO M 143 ..... 5 g. Sodium sulphite ..... 40 g. ORWO H 142 ..... 6 g. Potassium carbonate ..... 40 g. Potassium bromide ..... 3 g.	3 to 4 minutes strong

	Designation	Formula	Duration and Character of Development
	ORWO 72		
Neg PA Repr Pos	Multi-purpose Developer	Sodium sulphite..... 125 g. ORWO G 141 ..... 50 g. Potassium carbonate ..... 250 g. For use mix 1 part of developer with 3 to 4 parts of water	5 to 8 minutes soft to normal 1 to 2 minutes for photographic papers
	ORWO 73		
Repr	Compensating Reproduction Developer	ORWO M 143 ..... 1 g. Sodium sulphite ..... 40 g. ORWO H 142 ..... 6 g. Sodium carbonate ..... 20 g. Potassium bromide ..... 1 g.	4 to 5 minutes soft
	ORWO 74		
Repr	Strong Reproduction Developer	ORWO M 143 ..... 5 g. Sodium sulphite ..... 40 g. ORWO H 142 ..... 6 g. Potassium carbonate ..... 40 g. Potassium bromide ..... 6 g.	3 minutes hard and very clear
	ORWO 75		
Repr	Phosphate Developer	Citric acid ..... 5 g. ORWO H 142 ..... 25 g. Sodium sulphite ..... 40 g. Tripotassium-phosphate anhydrous ..... 110 g. Potassium bromide ..... 3 g. If when using tap water a flocculated deposit forms, this can be removed by filtering	3 to 4 minutes very hard
	ORWO 76		
Repr	Compensating Reproduction Developer	ORWO M 143 ..... 4 g. Sodium sulphite ..... 75 g. Sodium carbonate ..... 5 g. Potassium bromide ..... 2.5 g.	8 to 10 minutes normal
	ORWO 78		
Spez	Special Reproduction Developer	Solution A: Pyrocatechin ..... 25 g. make up to 1 litre Solution B: Sodium hydroxide ..... 10 g. make up to 1 litre Shortly before use mix 1 part A and 1 part B with 6 parts of water	1 to 2 minutes hard

	Designation	Formula	Duration and Character of Development
	ORWO 79		
Spez	Special Reproduction Developer with Stable Stock Solutions	Solution A: Potassium bisulphite ..... 4 g. Pyrocatechin ..... 30 g. make up to 1 litre Solution B: Sodium tetraborate ..... 20 g. Sodium hydroxide ..... 20 g. Potassium bromide ..... 1 g. make up to 1 litre For use mix equal parts of A and B	1½ minutes hard
	ORWO 80		
Repr	Very Strong Reproduction Developer	ORWO M 143 ..... 2.5 g. Sodium sulphite ..... 50 g. ORWO H 142 ..... 10 g. Potassium carbonate ..... 60 g. Potassium bromide ..... 4 g.	3 to 4 minutes very hard and clear
	ORWO 81		
Repr	Adjustable Reproduction Developer	ORWO M 143 ..... 7.5 g. Sodium sulphite ..... 40 g. ORWO H 142 ..... 3.5 g. Sodium carbonate ..... 30 g. Potassium bromide ..... 3 g. If used undiluted normal working; if diluted with 3 parts of water soft and 6 parts of water very soft	5 minutes adjustable
	ORWO 82		
Repr	Paraformaldehyde Developer for Super-Steep Working (Line- and Screen Material)	Solution A: Sodium sulphite ..... 60 g. boric acid, cryst. ..... 15 g. ORWO H 142 ..... 45 g. make up to 1 litre Solution B: Sodium sulphite ..... 0.5 g. Paraformaldehyde ..... 15 g. Potassium bisulphite ..... 5 g. Potassium bromide ..... 3 g. make up to 1 litre Shortly before use mix equal parts of A and B	4 to 6 minutes

Developers for Black-and-White Papers

	Designation	Formula	Duration and Character of Development
	ORWO 100		
Pos	Standard Developer	ORWO M 143 ..... 1 g. Sodium sulphite ..... 13 g. ORWO H 142 ..... 3 g. Sodium carbonate ..... 26 g. Potassium bromide ..... 1 g. The above mentioned substances can also be used for preparing 250 ml of concentrated stock solution. For use mix 1 part of developer with three parts of water.	1 to 2 minutes normal
	ORWO 105		
Pos	Softly Working Developer	ORWO M 143 ..... 15 g. Sodium sulphite ..... 75 g. Potassium carbonate ..... 75 g. Potassium bromide ..... 2 g. For use mix 1 part of developer with 4 to 5 parts of water.	1 to 2 minutes very soft
	ORWO 108		
Pos	Hard Working Developer (= ORWO 1)	ORWO M 143 ..... 5 g. Sodium sulphite ..... 40 g. ORWO H 142 ..... 6 g. Potassium carbonate ..... 40 g. Potassium bromide ..... 2 g.	1 to 2 minutes hard
	ORWO 110		
Spez	Hard Working Rapid Developer	Potassium hydroxide..... 26 g. Sodium sulphite ..... 100 g. ORWO H 142 ..... 60 g. Potassium bromide ..... 3 g.	1 minute rapid and hard
	ORWO 111		
Spez	Contrast Developer	Solution A: Potassium bisulphite ..... 40 g. ORWO H 142 ..... 40 g. Potassium bromide ..... 8 g. make up to 1 litre Solution B: Potassium hydroxide..... 100 g. make up to 1 litre For use mix 1 part A and 1 part B with two parts of water	40 to 50 seconds very hard

	Designation	Formula		Duration and Character of Development
	ORWO 115			
Pos Spez	Special Paper Developer	ORWO M 143 ..... Sodium sulphite ..... ORWO H 142 ..... Sodium carbonate ..... Potassium bromide	2 g. 25 g. 6 g. 33 g. 0.5 g.	2 minutes strong
	ORWO 120			
Pos	Brown Developer	Sodium sulphite ..... ORWO H 142 ..... Potassium carbonate ..... Potassium bromide	60 g. 24 g. 80 g. 2 g.	Notes on developers ORWO 120 to ORWO 124: According to the type of paper and required tone, the developers should be diluted up to a ratio of 1:5. With increasing dilution. The exposure and development times must be correspondingly extended.
	ORWO 122			
Pos	Brown Developer	Sodium sulphite ..... ORWO G 141 ..... ORWO H 142 ..... Potassium carbonate ..... Potassium bromide	30 g 5 g. 10 g 50 g. 5 g.	
	ORWO 123			
Pos	Brown Developer	Sodium sulphite ..... ORWO H 142 ..... Potassium carbonate ..... Potassium bromide	60 g. 24 g. 80 g. 25 g.	
	ORWO 124			
Pos	Olive-brown Developer	ORWO M 143 ..... Sodium sulphite ..... ORWO H 142 ..... Sodium carbonate ..... Potassium bromide	0.8 g. 15 g. 4 g. 9 g. 8 g.	

	Designation	Formula		Duration and Character of Development
	ORWO 125			
Pos	Developer for Document Papers	ORWO M 143 ..... Sodium sulphite ..... ORWO H 142 ..... Sodium carbonate ..... Potassium bromide	1.5 g. 30 g. 6 g. 45 g. 0.6 g.	1 to 2 minutes
	ORWO 126			
Pos	Developer for Document Papers	Sodium sulphite ..... ORWO H 142 ..... Potassium carbonate ..... Potassium bromide ..... For use mix 1 part of developer with 2 to 3 parts of water	125 g. 40 g. 250 g. 4.5 g.	1 to 2 minutes
	ORWO 130			
Pos Spez	Special Paper Developer	ORWO M 143 ..... Sodium sulphite ..... ORWO H 142 ..... Sodium carbonate ..... Potassium bromide	2.5 g. 30 g. 7 g. 30 g. 1 g.	1 to 2 minutes normal
	ORWO 131			
Pos Spez	Special Paper Developer	ORWO M 143 ..... Sodium sulphite ..... ORWO H 142 ..... Sodium carbonate ..... Potassium bromide	4.5 g. 26 g. 1 g. 21 g. 2.5 g.	1 to 2 minutes soft
	ORWO 135			
Spez	X-ray Paper-Developer (= ORWO 30)	ORWO M 143 ..... Sodium sulphite ..... ORWO H 142 ..... Sodium carbonate ..... Potassium bromide	3.5 g. 60 g. 9 g. 40 g. 3.5 g.	3 to 5 minutes

Other developers for photographic papers: **ORWO 20, ORWO 47, ORWO 72**

A	49	Finest Grain Developer
F	43	Fine-grain Developer
D	51	Bright Light Developer
H	02	Special Negative Developer
R	09	Developer Solution
M-H	28	Developer Solution
G	04	Developer Solution
E	102	Universal Developer Solution
N	103	Paper Developer
B	104	Special Paper Developer
A	71	Reproduction Developer
A	77	Reproduction Developer, Adjustable
A	82	Special Reproduction Developer
A	30	X-ray Developer
A	32	Special X-ray Developer
A	35	X-ray Surgical Developer
		X-ray Developing Set for Dental Films

ORWO Finest Grain Developer A 49

Finest grain developer, especially for miniature films and all photographic materials, the negatives of which are to be greatly enlarged. Compounded according to current experience, suitable for dish, box and tank development of long life, and economic in use. Good utilization of sensitivity. Even with highly-sensitive emulsion the developed silver has the finest grain. The negatives are compensated an appear delicate. Due to the brownish black colour of the silver positives of a good brilliancy result.

Commercial Sizes: Packs for 600 ml

2 litres
7½ litres
35 litres
70 litres

The packs contain substances in solid consistency: Part A separated into two smaller quantities, Part B one larger quantity.

Instruction for dissolving the 600-ml packs:

The two quantities belonging to Part A are dissolved simultaneously and completely in 400 ml of water of 30 to 45 °C. Subsequently the substance of Part B is added gradually, and dissolved completely, whilst stirring. Finally the mixture is topped up with water to 600 ml. The mixing of the solution must take place immediately after the preparation, as solution A on its own has only a limited life. If prepared correctly, the solution should be yellowish but clear.

Instruction for dissolving 2-, 7½-, 35- and 70-litre Packs:

The two quantitative belonging to Part A are dissolved according to the size of the pack, in water at 30 to 35 °C as follows:

Packs for	2	7½	35	70 litres developer
Dissolve Part A in ....½		1½	7	15 litres water

The solution thus obtained is poured into a larger container, or immediately into the tank to be used. Subsequently, as much cold water is added as is still required to make up a quarter of the total volume. It is absolutely essential to dilute the A solution with water in order to avoid precipitation when adding the B part. After dilution, part B is poured into it in small amounts whilst stirring thoroughly, topping up to the full volume of the packs. Stirring is continued until all substances are completely dissolved. The preparation of the developer should be carried out in one process, as solution A on its own has only a limited life. If prepared correctly, the solution should be yellowish but clear.

Instructions for the Use of ORWO Finest-grain Developer A 49

Developing times for ORWO Films and Plates at 20 °C

	Dish	Box	Tank
Miniature Films			
NP 10	—	about 4 minutes	4 to 5 minutes
NP 18	—	9 to 11 minutes	11 to 13 minutes
NP 22	—	9 to 11 minutes	11 to 13 minutes
NP 27	—	12 to 14 minutes	14 to 16 minutes
Roll Films			
NP 10	about 4 minutes	about 4 minutes	4 to 5 minutes
NP 18	9 to 11 minutes	9 to 11 minutes	11 to 13 minutes
NP 22	9 to 11 minutes	9 to 11 minutes	11 to 13 minutes
NP 27	12 to 14 minutes	12 to 14 minutes	14 to 16 minutes
NP 22 Portrait	9 to 11 minutes	9 to 11 minutes	11 to 13 minutes
Sheet Films			
Most types of ORWO sheet film	9 to 11 minutes	—	12 to 13 minutes
Plates			
Most types of ORWO photographic plates	9 to 11 minutes	—	12 to 13 minutes

See also under developing times for ORWO films and plates: Pp. 77 to 84

In the case of deviation of temperature, the developing times should be modified as follows:

Extension at 15 °C by 60%
at 18 °C by 25%

Reduction at 22 °C by 15%
at 24 °C by 30%

Capacity: 6 films can be developed in 600 ml. Only with the last film should the developing time be extended by 1 minute each.

The larger packs permit a much greater capacity when using regenerator **A 49 R**. In the 7-litre tank, up to 300 films can then be developed; in the larger tanks correspondingly more.

Especially well-balanced negatives are obtained if the developer is diluted without any detrimental properties occurring with regard to the negative. When diluted in a ratio of 1:1, the above-mentioned time should be extended by half; at 1:2 it should be doubled. Weaker dilutions are not recommended. It should be especially noted that diluted **A 49** developer solution should be stored in bottles filled to the brim. When there is an air layer in the bottle, the developing capacity is already reduced after two weeks.

ORWO Regenerator A 49 for Finest Grain Developer A 49

The prepared regenerator must not be used as a developer on its own. It may only be used for regenerating finest-grain developer **A 49** in accordance with the instructions for use.

Commercial Size: Pack for 5 litres of regenerator with substances in solid consistency: Part A separate in two small quantities, Part B in one larger quantity.

Instructions for Dissolving: The two quantities belonging to Part A are dissolved simultaneously in 4 litres of water at 30 to 40 °. Subsequently, Part B is added in small portions and dissolved. Top up to 4 litres. The regenerator should be prepared in one process, as solution A, on its own, has only a limited life.

To accelerate dissolving water of up to 45 °C may be used.
Naturally when using the regenerator the temperature should again be approximately 20 °C. It is advisable to store the regenerator in a well-closed bottle.

Instructions for Use: The developer, exhausted by the development, is replaced by the regenerator. It is used at the end of each working day to replenish to the original level of the developer. Thorough stirring is required. The stirred sedimentation deposits again overnight, so that on the following day a clean, regenerated developer solution is available. For an **A 49** tank preparation of 7¼ litres, two packs of regenerator of the 5 litres size may be used; for a tank of 35 litres 8 to 10; and for a 70 litre tank, 16 to 18 such packs. Working according to this method, the normal developing time is able to be maintained at a constant temperature, practically unchanged until the end. In large tanks, it is possible to develop several thousands of films in a constant fine grain and gradation. Maximum cleanliness of the tank should, of course, be ensured if it is used for such a long time and excessively accumulated sedimentation should be drained from time to time, replacing the lost developer with regenerator.

ORWO Fine-grain Developer F 43

Fine-grain and compensating developers for all types of photographic materials, including miniature films. Suitable for tanks and boxes, as well as for dish development. Very long life and great capacity.

Commercial Sizes: Packs for 600 ml, 5, 10, 35 and 70 litres. The packs contain the substances in solid consistency. They are separated into a smaller part A and a larger part B.

Instruction for Dissolving the 600 ml Pack:

With this size of pack, 500 ml of water at 30 to 40 °C are used, and part A dissolved in it. Subsequently, part B is added in small portions, and also completely dissolved while stirring or tilting continuously. After topping up to 600 ml, the developer solution must be crystal clear.

Preparation of the developer should be carried out in one process, as solution A has only a limited life.

Instructions for Dissolving the 5-, 10-, 35- and 70-Litres Packs:

For preparing a tank filling, part A is first dissolved in water at 30 to 45 °C (for larger packs, for example, in a plastic bucket, or a container with perfect enamel) by stirring continuously, the clear solution is poured into the tank and diluted with cold water. The following quantities of water are required:

Pack for	5	10	35	70 litres developer
dissolve Part A in	1	2	5	10 litres water
after dissolving top up to..	3	6	20	40 litres

It is indispensable to dilute the solution A with water in order to avoid precipitation on adding solution B.

Part B is, in every case, dissolved in a special container outside the water tank at 30° to 45 °C in the following quantities of water:

Pack for	5	10	35	70 litres developer
dissolve part B in	1½	3	10	20 litres of water

If there are no larger containers available, it is possible, for instance, to divide the 70-litres preparation of part B in two approximately equal quantities and to dissolve them each separately in a clean bucket.

Subsequently, solution B is poured into solution A in the tank and topped up with cold water to the final colume. The preparation of the developer should take place in one process, as solution A, on its own, has only a limited life.

It is also possible to use the following method:
After pouring the solution A into the tank, top this up to threequarters of its volume with water, and then add substance B in small amounts and dissolve whilst stirring vigorously. Subsequently, the tank is topped up with water to its required volume and mixed thoroughly.
To accelerate dissolving, it is recommended to use water of 30 °C to 45 °C. Cold water is heated by taking approximately a quarter, heating it to boiling point, and adding it back to the total quantity.
Prepared developer solution or partial solutions must, however, never be heated to boiling point.

Instructions for the Use of ORWO Fine-grain Developer F 43

Developing times for ORWO Films and Plates at 20 °C

	Dish	Tray	Tank
Miniature Films			
NP 10	—	about 4 minutes	4 to 5 minutes
NP 18	—	7 to 9 minutes	9 to 11 minutes
NP 22	—	7 to 9 minutes	9 to 11 minutes
NP 27	—	11 to 13 minutes	13 to 15 minutes
Roll Films			
NP 10	about 4 minutes	about 4 minutes	4 to 5 minutes
NP 18	7 to 9 minutes	7 to 9 minutes	9 to 11 minutes
NP 22	7 to 9 minutes	7 to 9 minutes	9 to 11 minutes
NP 27	11 to 13 minutes	11 to 13 minutes	13 to 15 minutes
NP 22 Portrait	7 to 9 minutes	7 to 9 minutes	9 to 11 minutes
Sheet Films			
Most types of ORWO sheet films	9 to 10 minutes	—	10 to 12 minutes
Plates			
Most types of ORWO photographic plates	8 to 10 minutes	—	10 to 12 minutes

See also under developing times for ORWO Films and Plates: Pp. 77 to 84

F 43 has a relatively low sensitivity to deviating temperatures and thus at temperatures ranging from 19 to 21 °C it is possible to work with the same developing time as with 20 °C; for strongly-deviating temperatures the developing time should be modified accordingly.

Extension at 15 °C by 60%	Reduction at 22 °C by 15%
at 18 °C by 25%	at 24 °C by 35%

Capacity: In the solution of a 600 ml pack, it is possible to develop approximately 10 miniature or roll films, working cleanly. After the development of two films, the developing time should be extended by approximately 1 minute.
Due to its special composition **F 43** developer is so stable that it can be kept for months in the tank. It is for instance possible to develop several thousands of films in a 70 litre tank using three to four regenerator packs for 10 litres each of concentrated solution and applying them correctly. The milky turbidity gradually developing in the **F 43** developer, as in all fine-grain developers of this kind, remains uniformely suspended when working cleanly, and does not deposit. It does not, therefore, interfere in any way with the development.

ORWO Regenerator F 43 R for the Fine Grain Developer F 43

The prepared regenerator solution must not be used as a developer on its own. It may only be used for regenerating fine-grain developer **F 43** in accordance with the instructions for use.

Commercial Sizes: Packs for 5 and 10 litres of concentrated regenerator solution with substances in solid consistency (Part A and B).

Instructions for Dissolving: Each part is separately dissolved in water at 30 to 45 °C.

Pack for 5	10 litres concentrated regenerator
dissolve Part A in 2½	5 litres of water
dissolve Part B in 2½	5 litres of water

Then solution B is poured into solution A. Thus, 5 or 10 litres of concentrated stock solution is obtained which should be kept in a well-closed bottle. The preparation of the regenerator should be carried out in one process, as solution A, on its own, has only a limited life.

Instructions for Use: The stock solution is diluted for use with water in a ratio of 1:1. At the end of each working day, it is used for topping up to the original level of the developer. In this manner the developer, exhausted by the development, is replaced. Thorough stirring is essential. The sedimentation thus stirred deposits again overnight, so that on the following day a clean regenerated developer solution is available. When working regularly in accordance with this method, the normal developing time may be maintained, practically unchanged, until the end.

For a **F 43** tank volume of 35 litres, 2 regenerator packs for 10 litres may be used, 4 regenerator packs for 70 litres. If, toward the end of the application, the replenishment, in accordance with the above instructions is no longer adequate, the regenerator solution may also be used without dilution in order to obtain sufficient density of the developed material.

ORWO Bright-Light Developer D 51

Gently-working negative developer, permitting the use of a relatively bright darkroom illumination (thus a bright-light developer) and, accordingly permitting controllable development.

Commercial Sizes: Packs for 600 ml.

The packs contain substances in solid consistency. They are separated into the smaller part A, and the larger part B.

Instructions for Dissolving:

Part A should be completely dissolved in 150 ml, part B in 400 ml of water at 30 to 45 °C.
Subsequently solution B is added to solution A while stirring, and is topped up to 600 ml with water. The mixing of the solutions should be carried out immediately after preparation, as solution A, on its own, has only a limited life. The developer is yellowish-brown.

Working hints:

Greatly underexposed photographs may still provide very good results, by the extension of developing time to double, but the grain becomes coarser. **D 51** developer provides the possibility of observing the development process of highspeed and ultra highspeed, unsensitized orthochromatic, panchromatic and infra-red sensitized material, at a relatively bright darkroom illumination.
After a developing time of three minutes, at a darkroom light provided by the respective material, work is continued with darkroom safe-light screen 113 D. This relatively bright light is a light to directly illuminate the films and plates, during the development process, at a distance of 75 cm. This distance may be temporarily reduced for examination.
Nevertheless, care is advisable with high-speed materials. With bright-light development, the development process may be easily followed. Over and under-exposures may, therefore, be largely compensated and the negative may be adapted in the contrast to a specific paper gradation. Adequate final rinsing should be ensured in order to avoid yellow coloration.

Capacity:

6 films can be developed in 600 ml. In this instance, the developing time should be extended only for the final films.

Instructions for the Use of ORWO Bright-Light Developer D 51

Developing Times for ORWO Films and Plates at 20 °C

	Dish	Tray	Tank
Miniature Films			
NP 10	—	about 5 minutes	6 to 7 minutes
NP 18	—	10 to 12 minutes	12 to 14 minutes
NP 22	—	10 to 12 minutes	12 to 14 minutes
NP 27	—	12 to 14 minutes	15 to 16 minutes
Roll Films			
NP 10	about 5 minutes	about 5 minutes	6 to 7 minutes
NP 18	10 to 12 minutes	10 to 12 minutes	12 to 14 minutes
NP 22	10 to 12 minutes	10 to 12 minutes	12 to 14 minutes
NP 27	13 to 14 minutes	13 to 14 minutes	15 to 16 minutes
NP 22 Portrait	10 to 12 minutes	10 to 12 minutes	12 to 14 minutes
Sheet Films			
Most types of ORWO sheet films	10 to 12 minutes	—	13 to 14 minutes
Plates			
Most types of ORWO hotographic plates	10 to 12 minutes	—	13 to 14 minutes

With deviating temperatures, the developing times should be modified as follows:

Extension at 15 °C by 60%
at 18 °C by 25%

Reduction at 22 °C by 15%
at 24 °C by 35%

ORWO Special Negative Developer H 02

Properties and Use:

1. **H 02** is intended especially for box development of ORWO-**NP 10** films. The developer utilizes the film speed so well that 10 DIN film can be exposed like 16 Din films. The **H 02** development is contrast-compensating, so that the otherwise steeply-working **NP 10** film has a wider exposure range. Very fine grain negatives with sharp contours and a normal density range are obtained. The negative permits great magnification and results in positives with fine detail of light and shade.
2. **H 02** is also suitable, in special instances, for box development of high-speed films such as **NP 18**. This material may be exposed as 21 DIN. The **H 02** development, therefore, has such a contrast-compensating effect, that the large exposure range thus obtained assists in bridging very great light contrasts. Very balanced negatives with sharp contours are obtained.

Size of Packs:

Pack for 400 ml of ready-for-use developer.

Instructions for Dissolving:

The contents of the bottle are poured into 360 ml of tap water at 20 °C. Then the small quantity of substance added is dissolved without shaking or tilting too much.

Developing Time: (20 °C/box)

NP 10 10 to 12 minutes
NP 18 12 to 14 minutes

Deviating Developer Temperatures:

The time given for 20 °C should be multiplied by the following factors, in case of temperature deviations:

at 16 °C by 1.35	at 22 °C by 0.85
at 18 °C by 1.15	at 24 °C by 0.70

Capacity/Life:

Three to four miniature films or roll films can be developed in a **H 02** pack. The development time for the third and fourth films should be extended by 1 to 2 minutes. Because of the limited life of the prepared **H 02** developer, the films must be developed one after the other. It is not advisable to store the developer, even in an air-tight closed bottle.

Greater Dilution:

H 02 may, if required, be diluted beyond 400 ml.
The specified developing times should then be multiplied by the following factors:

with 500 ml developer by a factor 1.3
with 600 ml developer by a factor 1.5
with 700 ml developer by a factor 1.8
with 800 ml developer by a factor 2.1

If the maximum contrast compensation is required with exposures against the light, it is possible to use the diluted developer with a correspondingly extended exposure, even without prolonging the developing time.
Suggestions: Processing in **H 02** 1:1 (400 ml topped up to 800 ml) at 20 °C

NP 18 approximately 18 min.
NP 10 approximately 16 min.

Intermediate Rinsing, Fixing, Rinsing, Drying:

After developing, the film is treated in the same manner as any other negative film.

Notes:

1. Due to the different intensity of agitation during box development, the negative contrast can be influenced by moving the film only at the beginning and then approximately every 2 minutes for a short time, the result being particularly well-compensated negatives. With a continuous agitation during the entire development time, stronger negatives are obtained.
2. The substances of the **H 02** developer are, like those of other photographic developers, non-toxic to man. If, due to a certain hyper-sensitivity, irritation of the skin occurs, rubber gloves should be worn during work. In case of open wounds, care should be taken in any case.
3. The desensitizer **D 903**, recommended generally for bright light development, is not suitable for **H 02**. When it is added the sensitivity-utilizing effect of the developer is compensated.
4. To avoid any defects due to wetting, it is recommended, when developing roll film **NP 18** in diluted **H 02**, first to dip the film in water for a few minutes prior to immersing it in the developer.

ORWO Developer Solution R 09

Well-proven negative developer, on the basis of paraminophenol. Adjustable by dilution within wide limits. Extreme utilization of sensitivity. Highly concentrated solution, long life.

Commercial Sizes: Bottles of 1/10 litre
1/4 litre
1 litre

In highly concentrated solution, this negative developer may also be kept for a few months in opened bottles. The small quantity of white salt depositing when stored for a prolonged period, as well as the increasing dark colour of the solution, has no influence on the developing capacity.

R 09 Developer Solution is diluted for use with tap or well water. With weak dilutions, **R 09** develops rapidly and contrasty. The dilution ratio 1:10 to 1:20 is, therefore, recommended only for large-size plates and films. Stronger dilutions have a flatter effect. For miniature photography, at least 40 parts of water have to be taken to 1 part of **R 09**. For the development of an especially delicate negative, the dilution can be increased to 1:200. The grain becomes increasingly finer; the utilization of the sensitivity is, however, maintained in all instances where the developing time is correspondingly extended. When it is exposed to air, the diluted **R 09** Developer has a reduced life.

Developers diluted to such an extent should be poured away after use. With greater dilutions, the developing times should be multiplied by the following factors, as compared to the figures given for 1:40:

Dilution	1:60	1:80	1:100	1:150	1:200
Extension factor	1.5	2.0	3.0	4.0	6.0

Instructions for the Use of ORWO Developer Solution R 09

Developing Times for ORWO Films and Plates at 20 °C

	Dish dilution 1:20	Tray dilution 1:40	Tank dilution 1:40
Miniature Films			
NP 10	—	about 4 min	4 to 5 min
NP 18	—	9 to 11 min	10 to 12 min
NP 22	—	9 to 11 min	10 to 12 min
NP 27	—	12 to 13 min	14 to 16 min
Roll Films			
NP 10	—	about 4 min	4 to 5 min
NP 18	4 to 6 min	9 to 11 min	10 to 12 min
NP 22	4 to 6 min	9 to 11 min	10 to 12 min
NP 27	6 to 8 min	12 to 13 min	14 to 16 min
NP 22 Portrait	4 to 6 min	9 to 11 min	10 to 12 min
Sheet Films			
Most types of ORWO sheet films	4 to 6 min	—	12 to 13 min
Plates			
Most types of ORWO photographic plates	4 to 6 min	—	12 to 13 min

See also under developing times for ORWO Films and Plates: Pp. 77 to 84

In the case of deviating temperatures, the developing times should be modified as follows:

Extension at 15 °C by 50%
at 18 °C by 20%

Reduction at 22 °C by 15%
at 24 °C by 30%

ORWO Developer Solution M-H 28

Universally-applicable rapid developer with good covering capacity. Concentrated Solution.

Commercial Sizes: Bottles of ¼ litre
½ litre
1 litre

Instructions for Use: For standard development of negative materials of larger sizes (above 6 cm × 9 cm) the concentrated solution is diluted with 5 to 6 parts of water with a developing time of 4 to 5 minutes at 20 °C usually being correct. In the case of over-exposures, it is advisable to dilute with only 2 to 5 parts of water and to develop for a shorter period. To 100 ml of developer, 2 to 3 ml of a 10% potassium bromide solution is then added. For under-exposures, approximately 8 parts of water are used for dilution, and development is extended accordingly.
For developing photographic papers, the concentrated solution is diluted according to the following table:

Type of paper	Enlarging Paper	Contact Paper White	Contact Paper Chamois
Dilution	1:2	1:2	1:3
Developing time	1½ to 3 min	1 min	1 to 2 min

Should occasionally-occurring precipitations not dissolve on tilting or shaking carefully, a uniform distribution of the precipitation within the concentrated solution should be ensured prior to measurement. After diluting with water, the solution is carefully tilted until it becomes clear.

With temperatures below —5 °C, greater precipitation may occur in the concentrated solution, but this, however, reduces on heating to 25 °C after 10 to 12 hours to such an extent that processing may be continued according to the abovementioned indication.

ORWO Developer Solution G 04

Very clear working developer. Concentrated solution.

Commercial sizes: Bottles of 1 litre

Instruction for Use: To use, with 4 to 5 parts of water are mixed. With negative development, very clear, harmoniously-adjusted negatives of good density are obtained. Dish development, 5 to 6 minutes. Tank development, 7 to 8 minutes at 20 °C.

G 04 is particularly sensitive to temperature fluctuations. For photographic paper development the developer may be used in the same dilution. It is, however, recommended to add 2 ml of a 10% potassium bromide solution to each 100 ml of diluted developer.

ORWO Universal Developer Solution E 102

Developer for neutrally-black tones on papers and transparencies. Suitable also as a negative developer for larger sizes. Concentrated solution.

Commercial Sizes: Bottles of ¼ litre
½ litre
1 litre

Instructions for Use: E 102 developer should be used primarily in a dilution of 1:7 to 1:8 for paper processing. Developing time is 1 to 2 minutes. The table below lists the tone then obtainable. **E 102** has also given good results in two-dish development. In this case, dilutions of 1:7 and 1:12 are used. For transparency material, a dilution of 1:6 is recommended.

E 102 is suitable also as a negative developer. One part of developer is diluted with 10 to 12 parts of water. At 20 °C, developing time is 4 to 5 minutes. The developer is unsuitable for high bath temperatures (above 22 °C). It contains caustic alkali which causes the gelatine to swell more in the heat and the fog to increase.

Precipitations in the concentrated solutions may occur at temperatures below +5 °C but these dissolve again after 10 to 12 hours, when heated to 25 °C.

E 102, N 103, B 104: Obtainable Tones

Developer	Type of Paper				
	Contact Paper		Enlarging Paper		Portrait Paper
	white	cream	white	cream	
E 102	pure black	warm black	pure black	warm black	warm black
N 103	pure black	warm black	pure black	brown-black	warm black
B 104	blue-black	brown-black	pure black	brown-black	warm black

ORWO Paper Developer N 103

Universally-applicable paper developer for neutrally-black tones.

Commercial Sizes: Packs of 200 ml (in tubes)
2½ litres
10 litres

Substances in solid consistency (Part A and B).

ORWO Special Paper Developer B 104

Special developer for blue-black tones.

Commercial Sizes: Packs of 2½ litres
10 litres

Substance in solid consistency (Part A and B).

Instructions for Dissolving ORWO N 103 and ORWO B 104 Developer

Part A is dissolved, according to the size of pack, in water at 30 to 45 °C.

Pack for	200 ml	2½	10 litres developer
Dissolve part A in ..	150 ml	2	7½ litres water

Part B is subsequently added while stirring thoroughly. After topping up with cold water to the final volume, in accordance with the size of pack, and heating to 20 °C, the developers are ready for use. The preparation of the developers should be carried out in one process, as solution A only has a limited life.

Instructions for Use: N 103 and **B 104**, similarly to **E 102**, provide the best results with most contact papers after a developing time of 50 to 60 seconds, and with enlarging papers, after 1½ to 2 minutes at 20 °C. The developers have additives and permit, thus, long developing times (approx. 5 minutes) without producing a grey or yellow fog.

Up to 400 prints 7.5 cm × 10.5 cm may be developed in one litre of developer.

ORWO Reproduction Developer A 71

Special developer for reproduction photography.
Commercial Sizes: Pack for 5 litres developer, substances in solid consistency (Part A and B).

Instructions for Dissolving: Part A of the pack is completely dissolved in 4 litres of water; subsequently substance B is added in small portions, also completely dissolved. and topped up with water to 5 litres.

Instructions for Use: The ready-for-use developer supplies contrasty negatives with all phototechnical types of films and plates at 20 °C, after 3 to 5 minutes development.

ORWO Reproduction Developer A 77

Adjustable developer for phototechnical material and survey film. The developer consists of three parts, which are mixed for use according to the required contrast (hard to soft).

Commercial Size: Packs for 5 litres partial solution each, substances in solid consistency (Part A1, A2, and B).

Instructions for Dissolving: The contents of part A1, A2 and B are separately dissolved each in 4 litres of water at 30 to 40 °C, while stirring continuously, and are then topped up to 5 litres.

Storage Life: The stock solutions, A1, A2 and B, should be stored in airtight bottles filled to the brim. Under these conditions they keep for some weeks.

Instructions for Use: To use, the developer is mixed from the three individual parts, The following contrasts may, for instance, be obtained by different mixing ratios:

Contrast	A1	A2	B	Water
hard	1	1	1	0
normal	1	1	1	9
soft*	2	0	1	9

* This dilution is suitable for infra-red film **NI 750.**
The more strongly diluted solutions are intended for quicker use.

Developing Time: 5 minutes at 20 °C in the dish.

ORWO Soecial Reproduction Developer A 82

The developer is especially suitable for the processing of super-steep working line and screen materials (FO 6).
It supplies maximum contrast with good clarity. The developer is prepared by pouring together two stock solutions prepared separately.

Commercial Size: Pack for 2½ litres solutions each, substances in solid consistency (Part A and B).

Instructions for Dissolving:

Solution A

The contents of part A are completely dissolved in 2 litres of water at approximately 30 °C whilst stirring continuously and then topped up with 2½ litres. Any turbidity occurring is of no consequence to the photographic result.

Solution B

The contents of part B are completely dissolved in 2 litres of water at approximately 30 °C by stirring continuously, and then topped up to 2½ litres.

Storage: The two stock solutions A and B should be stored in airtight bottles, filled to the brim.

Instructions for Use: Shortly before use, the developer is mixed from equal parts of stock solutions A and B. The life of the prepared developer is limited (in an open dish to about ½ hour).

Developing Time: 4 to 6 minutes at 20 °C in the dish (continuous, energetic agitation).

ORWO X-Ray Developer A 30

X-ray developer for good clarity and high contrast.

Commercial Size: Packs for 1 litre
4½ litres
9 litres
13½ litres

Substances in solid consistency (Part A and B).

Instructions for Dissolving: Part A is dissolved, according to the size of the pack, in water at 30 to 45 °C.

Pack for	1	4½	9	13½ litres developer
dissolve Part A in	²/₅	3	6	9 litres of water

After dissolving completely Part B is added gradually, whilst stirring continuously. Finally the solution is topped up with cold water to the final volume, according to the size of the pack.

Instructions for Use: When developing X-ray exposures, the best contrast on most types of X-ray film is obtained at a temperature of 20 °C after a developing time of 5 minutes. To achieve the same good results, the temperature of the developer should be determined accurately and the developing time taken from the following table:

Developing time for ORWO X-ray Films

18 °C	6 minutes
20 °C	5 minutes
22 °C	4 minutes
24 °C	3 minutes

See also the developing times for films and plates: pages 79, 82, 84.

Capacity: In the course of using the developer, the increasing exhaustion of the developer solution must be compensated by extension of the developing time. In the interest of uniformity of the result, it is better to use ORWO X-ray regenerators **A 30 R**.

ORWO Regenerator A 30 R for X-Ray Developer A 30

The regenerator must not be used as a developer on its own. It can only be used for replenishing the developer **A 30** in accordance with the instructions for use.

Commercial Sizes: Packs for 5 litres concentrated regenerator solution, substances in solid consistency (Part A, B and C).

Instructions for Dissolving:
First, part A is dissolved in 4½ litres of water at 30 to 45 °C. Part B is added slowly to the dissolved part A, whilst stirring continuously; it does not dissolve completely but produces a milky suspension. Complete solution takes place only after adding part C. (Caution! caustic substance! use protective goggles). Finally, the total volume of 5 litres is made up with water. The concentrated solution obtained in this manner must be crystal clear.

Instructions for Use: The concentrated regenerator solution is stored in a bottle of suitable size, with as little air above the solution as possible. Regeneration takes place by frequent replacement of the exhausted developer. For this purpose, only the quantity required at a certain time is prepared from the concentrated regenerator solution with water in a ratio of 1:1 and added immediately to the developer whilst stirring. The more frequently the developer is replenished in this manner to the full tank volume (maximum level of the solution can, if necessary, be marked) the more uniform become the results of development. (For instance, topping up after each 10 to 15 sheets of X-ray film, 30 cm x 40 cm.) When carried out regularly in this manner, the same contrast is always obtained with a constant temperature and constant developing times. With a particularly strong exhaustion; or in case of irregularities in replenishing; or in the case of a higher contrast being required, replenishing may also be carried out with undiluted regenerator solution. Not more than 200 ml of undiluted regenerator solution per litre of developer should, however, be added at one time. The limit of utilization of the developer is usually reached when the added quantity of regenerator solution (1:1) equals the original filling of the tank with developer.

ORWO X-Ray Developer A 30

X-ray developer for good clarity and high contrast.

Commercial Size: Packs for 1 litre
4½ litres
9 litres
13½ litres

Substances in solid consistency (Part A and B).

Instructions for Dissolving: Part A is dissolved, according to the size of the pack, in water at 30 to 45 °C.

Pack for	1	4½	9	13½ litres developer
dissolve Part A in	⅔	3	6	9 litres of water

After dissolving completely Part B is added gradually, whilst stirring continuously. Finally the solution is topped up with cold water to the final volume, according to the size of the pack.

Instructions for Use: When developing X-ray exposures, the best contrast on most types of X-ray film is obtained at a temperature of 20 °C after a developing time of 5 minutes. To achieve the same good results, the temperature of the developer should be determined accurately and the developing time taken from the following table:

Developing time for ORWO X-ray Films

18 °C	6 minutes
20 °C	5 minutes
22 °C	4 minutes
24 °C	3 minutes

See also the developing times for films and plates: pages 79, 82, 84.

Capacity: In the course of using the developer, the increasing exhaustion of the developer solution must be compensated by extension of the developing time. In the interest of uniformity of the result, it is better to use ORWO X-ray regenerators **A 30 R**.

ORWO Regenerator A 30 R for X-Ray Developer A 30

The regenerator must not be used as a developer on its own. It can only be used for replenishing the developer **A 30** in accordance with the instructions for use.

Commercial Sizes: Packs for 5 litres concentrated regenerator solution, substances in solid consistency (Part A, B and C).

Instructions for Dissolving:

First, part A is dissolved in 4½ litres of water at 30 to 45 °C. Part B is added slowly to the dissolved part A, whilst stirring continuously; it does not dissolve completely but produces a milky suspension. Complete solution takes place only after adding part C. (Caution! caustic substance! use protective goggles). Finally, the total volume of 5 litres is made up with water. The concentrated solution obtained in this manner must be crystal clear.

Instructions for Use: The concentrated regenerator solution is stored in a bottle of suitable size, with as little air above the solution as possible. Regeneration takes place by frequent replacement of the exhausted developer. For this purpose, only the quantity required at a certain time is prepared from the concentrated regenerator solution with water in a ratio of 1:1 and added immediately to the developer whilst stirring. The more frequently the developer is replenished in this manner to the full tank volume (maximum level of the solution can, if necessary, be marked) the more uniform become the results of development. (For instance, topping up after each 10 to 15 sheets of X-ray film, 30 cm × 40 cm.) When carried out regularly in this manner, the same contrast is always obtained with a constant temperature and constant developing times. With a particularly strong exhaustion; or in case of irregularities in replenishing; or in the case of a higher contrast being required, replenishing may also be carried out with undiluted regenerator solution. Not more than 200 ml of undiluted regenerator solution per litre of developer should, however, be added at one time. The limit of utilization of the developer is usually reached when the added quantity of regenerator solution (1:1) equals the original filling of the tank with developer.

ORWO Special X-Ray Developer A 32

Developers for maximum utilization of the practical sensitivity of X-ray films. When using this developer the radiation exposure can be reduced by as much as 40%, depending on the type of film. When adhering to the specified developing time, the image quality corresponds to the results of X-ray developer **A 30**.

Commercial Sizes: Packs for 4½ and 13½ litres. Substances in solid consistency (Part A and B).

Instructions of Dissolving: The contents of part A are dissolved in water of 20 to 30 °C

in 4 litres of water for the 4½ litre pack,
in 12 litres of water for the 13½ litre pack.

Part B is added to the solution (which still looks somewhat turbid in the case of hard water), whilst stirring continuously and is completely dissolved. Then the final volume is topped up with cold water, according to the size of the pack.

Instructions for Use:

Developing time 4 to 5 minutes at 20 °C.
In the case of differing temperatures, the following times apply:

18 °C	6 to 7 minutes
22 °C	3 to 4 minutes
24 °C	2½ to 3 minutes

See also developing times for films: pages 79, 80.

When these developing conditions are maintained, the most favourable results may be expected with regard to sensitivity on the one hand and to clarity and graininess on the other.

In the course of utilization of the developer, the increasing exhaustion of the solution must be compensated by

ORWO X-ray Regenerator **A 32 R**,

an extension of the developing time not being necessary.

ORWO Regenerator A 32 R for Special X-Ray Developer A 32

The regenerator is intended only for the regeneration of developer **A 32**. It is not suitable as a developer on its own.

Commercial Size: Pack for 5 litres of solution. Substances in solid consistency (Part A and B).

Instructions for Dissolving: Part A is first dissolved completely in 4½ litres of water of 20 to 30 °C and Part B is subsequently added to the solution, still looking somewhat turbid, finally topping up to the total volume of 5 litres.

Instructions for Use: The regenerator solution obtained in this manner is stored in a bottle of suitable size (with as little air as possible above the solution). It serves for the regeneration of the **A 32** developer. Regeneration is effected by the most frequently possible replacement of the quantity of developer removed from the tank with the film. The more frequently the developer is replenished in this manner to the full tank volume, (maximum level of the solution to be marked, if required) the more uniform will be the results of development.

The life of a developer preparation is usually terminated when the entire quantity of the added regenerator solution equals the original filling of the tank with developer.

ORWO X-Ray Developing Set for Dental Films

Developing set for the Dental Surgeon's practice, conveniently arranged, contains the X-ray Developer **A 30**, and ORWO-X-ray rapid fixing salt **A 314**.

Commercial Sizes: Packs for 150 ml
600 ml

Substances in solid consistency.

Developers are supplied in both instances as part A and B. In the 600 ml pack, part A is in a separate, closed glass tube. In the 150 ml pack, it is in a bottle in part B, in an insert beneath the screw fitting. The fixing salt consists of a mixture, but is divided in the 150 ml pack into two glass tubes for easier packing, the contents of both producing 150 ml of fixing bath.

Instructions for Dissolving: Developer: Part A is completely dissolved, according to pack, in water of 30 to 45 °C.

Pack for	150	600 ml developer
dissolve part A in	100	400 ml of water.

Subsequently the substance of part B is gradually added and completely dissolved by agitating thoroughly. Finally, water is used for topping up to 150 or 600 ml.

Fixing Bath: The fixing bath is prepared, according to the size of the pack, with only about 4/5 of the final quantity of water, whereby an increase of the water temperature to around 25 °C accelerates the dissolving of the salt mixture. Subsequently, water is used for topping up to 150 or 600 ml.

Instructions for Use: The developer containers should correspond to the size of the pack. Dishes or tanks designed for dental film development. In order to avoid damage to the dental film during darkroom processing, suitable film clips should be used, which engage into the punched hole of the dental film. The working temperature of the baths should, if possible, be 20 °C. After a developing time of 5 minutes, brief but strong rinsing should be carried out, or a stop bath (**ORWO 200**, see page 87) should be used, and then the films should be put into the fixing bath for 10 minutes. Final rinsing and drying are carried out as usual.

Life and Utilization: During intervals between the work, the dishes and tanks should be well covered. Longer use of the developer is achieved by pouring it back into brown bottles, which should, if possible, be filled to the brim. 100 dental films, 3 × 4 cm, can be developed in 150 ml of developer, and in 600 ml 400 films of the same size. In the course of utilization, the increasing exhaustion of the developer solution should be compensated, usually be extending the developing time.

A 3 | ORWO Developer Substances

ORWO Developer Substance A 140

Developing agent (1-hydroxy-2.4 diaminobenzine hydrochloride), readily soluble in water for black and white and colour photography.

Commercial Sizes: Bottles of 100 g.
1000 g.

A 140 already has developing power in an aqueous sodium sulphite solution without the addition of alkali. Alkali-free developers are particularly suitable for the processing of photographic material in the tropics, as the fogging effect is small at an increased temperature. **A 140** has no toxic effect on sensitive skin.

On storage, **A 140** becomes grey. This does not impair its photographic qualities. **A 140** does not keep as long as M-H developer, but nevertheless **A 140** solution may be kept for many weeks in airtight bottles, filled to the brim. (Decomposition of **A 140** developer cannot be detected by the colour becoming dark, as decomposed **A 140** also has a bright colour.)

Developers for Self-preparation:

ORWO 39 (special developer for K plates see page 85).

ORWO 47 (black and white negative and positive developer see page 31).

ORWOCOLOR 09 (First-developer for ORWOCOLOR reversal films see page 136).

ORWO Developer Substance G'141

Developer substance (para-hydroxyphenylglycin) for preparing very clear and without fog working black and white developers.

Commercial Sizes: Bottles of 100 g.
1000 g.

G 141 dissolves in water only with difficulty. When preparing the developer, the substance should, therefore, be added only after dissolving the sodium sulphite (or the alkali).

G 141 works slowly and clearly with sodium or potassium carbonate. With caustic alkalis, it produces decidedly rapid developers.

G 141 is a white crystalline powder. An addition of stabilizer protects it from discolouring during storage. **G 141** developer is very sensitive to impurities (fixing salt). Absolute cleanliness in working is, therefore, essential. **G 141** developers react relatively strongly to temperature influences.

Developers for Self-preparation:

ORWO 8 (standard negative developers see page 31).

ORWO 72 (developer for negative and reproduction materials, as well as for photographic papers, see page 36).

ORWO 122 (paper developer for reddish tones, see page 40).

ORWO Developer Substance H 142

Universally-applicable developer substance (hydroquinone) primarily for black an white negative and positive developer.

Commercial Sizes: Bottles of 100 g.
1000 g.

H 142 is readily soluble in water. **H 142** is used only in conjunction with caustic alkalis for the preparation of hard-working developers. In conjunction with **M 143**, there are a number of possible combinations of developers for negative as well as positive techniques. Most of the usual developers contain **M 143** and **H 142**.

H 142 is supplied pure in the form of long glistening withe needles.

Developers for Self-preparation: List, page 30.

ORWO Developer Substance M 143

Developer substance which is readily soluble in warm water (monomethyl-p-amino-sulphate) especially for black-and-white negative and positive developers.

Commercial Sizes: Bottles of 100 g.
1000 g.

M 143 produces (like **A 140**) a developing solution only with sodium sulphite and without alkalis. When small quantities of alkali are added (but a large addition of sodium sulphite), **M 143** produces good fine-grain developers (see also formulae **ORWO 12** to **16**, pages 31, 32). When further alkalis are added **M 143**, in conjunction with **H 142**, produces strong dense negatives and positives (see formulae **ORWO 40** and **ORWO 100**, pages 33 and 39).

M 143 consists of colourless, fine crystalline powder. In preparation, it should be ensured that **M 143** is dissolved before the sodium sulphite. Otherwise precipitations occur which can be dissolved only with difficulty.
As the best-known and most frequently used developer substance, **M 143** is included in many formulae.

Developers for Self-preparation: List, P. 30.

A 4 | Developing Times for ORWO Films and Plates in the most usual ORWO Developers

The following tables contain further details regarding the processing of all black-and-white ORWO materials, in the developers recommended by VEB Filmfabrik Wolfen, in addition to the notes in sections A 1 and A 2. It should be noted that developers with the designation of ORWO should be self-prepared, whilst ready-prepared developers have a symbol (capital letter and figure).

ORWO Miniature Films:

Developing times in minutes at 20 °C

Type of Film	F 43	A 49	R 09 1:40	R 09 1:100	ORWO 14
	Box				
NP 10	about 4	about 4	about 4	about 12	5 to 6
NP 18	7 to 9	9 to 11	9 to 11	27 to 33	10 to 12
NP 22	7 to 9	9 to 11	9 to 11	27 to 33	10 to 12
NP 27	11 to 13	12 to 14	12 to 13	—	—
NP 3	7 to 9	9 to 11	9 to 11	27 to 33	10 to 12
NP 5	7 to 9	9 to 11	9 to 11	27 to 33	10 to 12
NI 750	7 to 8	8 to 9	—	—	10 to 12
	Tank				
NP 10	4 to 5	4 to 5	4 to 5	—	6 to 8
NP 18	9 to 11	11 to 13	10 to 12	—	12 to 15
NP 22	9 to 11	11 to 13	10 to 12	—	12 to 15
NP 27	13 to 15	14 to 16	14 to 16	—	—
NP 3	9 to 11	11 to 12	11 to 12	—	12 to 15
NP 5	9 to 11	11 to 12	11 to 12	—	12 to 15
NI 750	9 to 10	10 to 11	—	—	12 to 15

ORWO Roll Films:

Developing times in minutes at 20 °C

Type of Film	F 43	A 49	R 09 1:40	R 09 1:100	M-H 28 1:6
	Dish or Box				
NP 10	about 4	about 4	about 4	about 12	—
NP 18	7 to 9	9 to 11	9 to 11	27 to 33	4 to 5
NP 22	7 to 9	9 to 11	9 to 11	27 to 33	4 to 5
NP 22 Portrait	7 to 9	9 to 11	9 to 11	27 to 33	4 to 5
NP 27	11 to 13	12 to 14	12 to 13	—	about 6
	Tank				
NP 10	4 to 5	4 to 5	4 to 5	—	—
NP 18	9 to 11	11 to 13	10 to 12	—	—
NP 22	9 to 11	11 to 13	10 to 12	—	—
NP 22 Portrait	9 to 11	11 to 13	10 to 12	—	—
NP 27	13 to 15	14 to 16	14 to 16	—	—

ORWO Portrait and Sheet Films:

Developing times in minutes at 20 °C

Type of Film	Dish			Tank		
	F 43	A 49	R 09 1:20	F 43	A 49	R 09 1:40
NP 18	8 to 10	9 to 11	4 to 6	10 to 12	12 to 13	12 to 13
NP 21	8 to 10	9 to 11	4 to 6	10 to 12	12 to 13	12 to 13
NP 22	8 to 10	9 to 11	4 to 6	10 to 12	12 to 13	12 to 13
NP 27	11 to 13	12 to 14	6 to 8	13 to 15	14 to 16	14 to 16

ORWO Photographic Plates:

Developing times in minutes at 20 °C

Type of Plate	F 43	A 49	R 09 1:20	M-H 28 1:6	ORWO 41
	Dish				
NO 20	8 to 10	9 to 11	4 to 6	4 to 5	4
NP 20	8 to 10	9 to 11	4 to 6	4 to 5	4
NP 22	8 to 10	9 to 11	4 to 6	4 to 5	4
NP 22 Portrait	8 to 10	9 to 11	4 to 6	4 to 5	4
NP 27	10 to 12	12 to 13	6 to 8	about 6	5

Type of Plate	F 43	A 49	R 09 1:40	ORWO 42	ORWO 44
	Tank				
NO 20	10 to 12	12 to 13	12 to 13	8 to 10	15 to 18
NP 20	10 to 12	12 to 13	12 to 13	8 to 10	15 to 18
NP 22	10 to 12	12 to 13	12 to 13	8 to 10	15 to 18
NP 22 Portrait	10 to 12	12 to 13	12 to 13	8 to 10	15 to 18
NP 27	12 to 14	14 to 16	14 to 16	10 to 12	—

ORWO X-ray Films:

Developing times in minutes at 20 °C

Type of Film	Tank	
	A 30 ORWO 30	A 32
RF 2	5	4 to 5
RF 3	5	4 to 5
RF 21	5	4 to 5
RF 6	5	4 to 5
RF 61	5	4 to 5
RF 62	5	4 to 5
RF 63	5	4 to 5
RF 64	5	4 to 5
RF 65	5	5 to 5
RF 5	6 to 7	6
RS 2	5	5
DD 1	4 to 6	–

ORWO Phototechnical Films:

Developing times in minutes at 20 °C

Type of Film	A 71 ORWO 71	A 77	A 78 ORWO 78	A 82 ORWO 82	ORWO 70b	ORWO 72	ORWO 73	ORWO 76
FO 1	4 to 5	5	—	—	—	5 to 8	4 to 5	8 to 10
FO 15	4 to 5	5	—	—	—	—	—	—
FP 1	4 to 5	5	—	—	—	5 to 8	4 to 5	8 to 10
FU 2/21	4 to 5	5	—	—	—	5 to 8	4 to 5	—
FP 2	4 to 5	5	—	—	—	5 to 8	4 to 5	—
FU 3	4 to 5	5	—	—	2 to 3	—	—	—
FU 31/32	4 to 5	5	—	—	—	—	—	—
FP 3	4 to 5	5	—	—	2 to 3	—	—	—
FO 4	4 to 5	5	—	—	2 to 3	—	—	—
FO 41	3	3	—	—	—	—	—	—
FP 4	4 to 5	5	—	—	2 to 3	—	—	—
FU 5	3	3	—	—	—	—	—	—
FO 5	3	3	—	—	—	—	—	—
FO 51	3	3	—	—	—	—	—	—
FO 52	—	—	1 to 2	—	—	—	—	—
FO 6	4 to 5	5	—	4 to 6	—	—	—	—
VF 2 to 4	—	5	—	—	—	—	—	—

DK 3: For strong negative, 4 to 6 minutes in N 103, A 71, ORWO 20, ORWO 50, ORWO 71.
For normal negative, 8 to 10 minutes in F 43.

ORWO Phototechnical Plates:

Developing times in minutes at 20 °C

Type of Plate	A 71 ORWO 71	A 77	ORWO 70b	ORWO 72	ORWO 73	ORWO 76
FO 1	4 to 5	5	—	5 to 8	4 to 5	8 to 10
FP 1	4 to 5	5	—	5 to 8	4 to 5	8 to 10
FU 2	4 to 5	5	—	5 to 8	4 to 5	—
FP 2	4 to 5	5	—	5 to 8	4 to 5	—
FU 3	4 to 5	5	2 to 3	—	—	—
FP 3	4 to 5	5	2 to 3	—	—	—
FD 4	4 to 5	5	2 to 3	—	—	—
FP 4	4 to 5	5	2 to 3	—	—	—
FU 5	3	3	—	—	—	—
FU 51	3	3	—	—	—	—
FO 5	3	3	—	—	—	—

ORWO Material for Transparencies:

Different negative and positive developers may be used for developing. The choice of developer influences the properties of the transparency. Normally, developing takes 2 to 3 minutes.
With weak negatives, development may be extended to 5 minutes, changing the exposure time accordingly.
It is equally possible with hard negatives to reduce developing to 1 minute. The following tables give an indication of the change of contrast for some developers with normal processing.

Type of Film or Plate	R 09 1:20	M-H 28 1:4	E 102 1:6
DF 1	soft	normal	normal
PF 1	soft	normal	normal
DU 2	soft	normal	normal
DU 3	normal	hard	hard

Type of Film or Plate	N 103	ORWO 20	ORWO 22
DF 1	strong	strong	hard
PF 1	strong	strong	hard
DU 2	strong	strong	hard
DU 3	very hard	very hard	very hard

ORWO Materials for Science and Technology:

Developing times in minutes at 20 °C

Plates	M-H 28 1:4	R 09	F 43	A 30
	Dish			
WU 1	3 to 4	*4 to 6	8 to 10	—
WU 2	3 to 4	*4 to 6	8 to 10	—
WU 3	3 to 4	*4 to 6	8 to 10	—
WU 4	3 to 4	*4 to 6	8 to 10	—
WO 1	3 to 4	*4 to 6	8 to 10	—
WO 3	3 to 4	*4 to 6	8 to 10	—
WP 1	3 to 4	*4 to 6	8 to 10	—
WP 3	3 to 4	*4 to 6	8 to 10	—
WT 2	3 to 4	*4 to 6	8 to 10	—
MO 1	—	*5 to 7	8 to 10	—
LU 1	—	—	—	—
LP 1	—	—	—	—
ZU 1	4 to 5	5 to 6	10 to 12	4 to 5
ZU 2	4 to 5	5 to 6	10 to 12	4 to 5
ZP 1	4 to 5	5 to 6	10 to 12	4 to 5
ZP 2	4 to 5	5 to 6	10 to 12	4 to 5
TO 1	—	**10	8 to 10	—
EU 1	—	—	—	5 to 6
EU 2	—	—	—	5 to 6
EU 3	—	—	—	5 to 6
RO 1	5	—	—	5 to 6
RP 1	5	—	—	5 to 6
UV 1	3 to 4	*5 to 7	8 to 10	—
UV 2	—	—	4 to 6 (18 °C)	—

* Dilution 1:20
** Dilution 1:200

Developing times in minutes at 20 °C | in seconds

ORWO 1	ORWO 14	ORWO 20	ORWO 30	ORWO 40	ORWO 36	ORWO 111
Dish						
4 to 5	—	—	—	—	25 to 45	40 to 50
4 to 5	—	—	—	—	25 to 45	40 to 50
4 to 5	—	—	—	—	25 to 45	40 to 50
4 to 5	—	—	—	—	25 to 45	40 to 50
4 to 5	—	—	—	—	25 to 45	40 to 50
4 to 5	—	—	—	—	25 to 45	40 to 50
4 to 5	—	—	—	—	25 to 45	40 to 50
4 to 5	—	—	—	—	25 to 45	40 to 50
—	—	—	—	—	—	—
4 to 5	—	—	—	4 to 5	—	—
4 to 5	—	—	—	4 to 5	—	—
4 to 5	12 to 15	—	4 to 5	—	—	—
4 to 5	12 to 15	—	4 to 5	—	—	—
4 to 5	12 to 15	—	4 to 5	—	—	—
4 to 5	12 to 15	—	4 to 5	—	—	—
4 to 5	—	—	5 to 6	—	—	—
4 to 5	—	—	5 to 6	—	—	—
4 to 5	—	—	5 to 6	—	—	—
4 to 5	—	—	5 to 6	—	—	—
4 to 5	—	—	5 to 6	—	—	—
4 to 5	—	—	—	—	—	—
—	—	—	—	—	—	—

Developing times in minutes at 20 °C

Plates	M-H 28 1:4	R 09 1:100	F 43	A 30
	Dish			
750	3 to 4	10 to 12	5 to 6	—
850	3 to 4	10 to 12	5 to 6	—
950	3 to 4	10 to 12	5 to 6	—
1050	3 to 4	10 to 12	5 to 6	—
K 102	3 to 4	—	—	—
K 105	3 to 4	—	—	—
K 2, K 3, K 4, K 5	Special processing see p. 85			

Films	M-H 28 1:4	A 30	ORWO 20	ORWO 30
	Dish or Tray			
DR 1	—	5	3	5
DR 2	—	5	—	5
AF 3	—	5	—	5
AF 4	—	5	—	5
AF 55	—	5	—	5
HP 1	5	—	—	—
HP 2	5	—	—	—

The following procedure is recommended for developing **K-Plates:**

Thickness in µm	400	300	200	100	50
1. **Soaking** in distilled water at 20 °C					
minutes	120	90	60	30	15
2. **Cold development** at 5 °C: ORWO 39, undiluted					
minutes	80	60	40	40	40
3. **Warm development** at 20 °C: ORWO 39, 1:4.4 dilution					
minutes	100	90	80	40	20

4. **Stopping** at 5 °C, for 40 minutes in 10 ml glacial acetic acid to 1 litre of water.

5. **Fixing** until clearing and in addition to this half the time for clearing.
   Fixing bath: to 4 litres of water, 1.720 kg. of crystalline sodium thiosulphate.

6. **Rinsing** by gradual dilution of the fixing bath (for plates of 200 µm thickness, change over to pure water in 5 to 6 hours, then a further 3 to 4 hours; other emulsion thicknesses accordingly). Finally rinse for 30 minutes in 20 ml of glycerine to 1 litre of water.

Change over slowly from lower to higher temperatures between the third and fourth processing stages, and the fourth and fifth, rinsing briefly with water.
To avoid distortions, dry slowly and carefully; where no special equipment is available, dry at room temperature in still air.

ORWO 39

Water	750	ml
Sodium sulphite, anhydrous (for K 5 ... 13.5 g.)	18	g.
10% potassium bromide solution	8	ml
Boric acid	35	g.
Developer substance A 140	4.5	g.
Top up with water to make	1	litre

(Caution! Dissolve the substances in the stated sequence. The prepared developer solution has only a limited life!)

ORWO Cine-Films 70, 35, 32 and 16 mm Negative/Positive

Developing times in minutes at 20 °C

	ORWO 14	ORWO 19		ORWO 20	ORWO 22
	Tank	Tank	Machine	Machine	Machine
NP 2	6 to 8	4 to 5	about 4	—	—
NP 3	12 to 15	9 to 12	6 to 9	—	—
NP 5	12 to 15	9 to 12	7 to 10	—	—
NP 7	—	12 to 15	9 to 12	—	—
NP 71	—	12 to 15	9 to 12	—	—
NI 750	10 to 12	—	4 to 7	—	—
TF 6	—	—	—	4 to 6	—
DN 1	—	—	5 to 8	—	—
DN 2	—	—	5 to 8	—	—
DP 1	—	—	6 to 8	—	—
DP 2	—	—	6 to 8	—	—
DP 3	—	—	6 to 8	—	—
PF 1	—	—	—	3 to 5	4 to 5
PF 2	—	—	—	3 to 5	4 to 5
PF 11	—	—	—	3 to 5	4 to 5

B | ORWO Formulae for Stop Baths

Designation	Formula		Duration of Processing
ORWO 200	Glacial Acetic acid*	20 ml	20 to 30 seconds
	top up to 1 litre		
ORWO 201	Potassium metabisulphite	40 g.	20 to 30 seconds
	top up to 1 litre		
ORWO 202	Sodium bisulphite lye**	75 ml	20 to 30 seconds
	top up to 1 litre		
ORWO 203			
for higher temperatures	Sodium sulphate	100 g.	10 to 20 seconds
	Glacial acetic acid*	20 ml	
	top up to 1 litre		

Supplement

* When using acid acetic of lower concentration, the stated quantities should be converted percentually-

** Quantity of sodium hydrogen sulphite solution (bisulphite lye) for a content of 37% of sodium hydrogen bisulphite, specific gravity 1.36.

C1 | ORWO Fixing-Bath Formulae

The quantities stated apply to crystalline sodium thiosulphate, the consistency of this salt being that in which it is on the market.

If anhydrous sodium thiosulphate is available, the values must be converted as follows:

1 gr. of crystalline sodium thiosulphate = 0.64 gr. anhydrous.

The quantities of the formulae stated apply to topping to make up 1 litre.

Designation	Formula			Suitable as
ORWO 300				
Acid Fixing Bath	Sodium thiosulphate	200	g.	Fixing bath for papers
	potassium metabisulphite			
	or			
	Sodium hydrogen sulphite	20	g.	
ORWO 301				
Acid Fixing Bath	Sodium thiosulphite	250	g.	Fixing bath for films and plates
	Sodium hydrogen sulphite	15	g.	
	or			
	Sodium hydrogen sulphite lye**	40.	ml	
ORWO 302				
Hardening Solution for ORWO 300	To 1 litre ORWO 300 the following solution is added:			Hardening fixing bath for papers
	Water	150	ml	The insertion of a acid stop bath (ORWO 200 to 203) after developing recommended
	Potash alum	15	g.	
	(dissolve at 40 to 50 °C and cool down to 20 °C)			
	Sodium sulphite anhydrous	7.5	g.	
	Glacial acetic acid*	12	ml	
ORWO 303				
Strong Fixing Bath for Negative Material	Sodium thiosulphate	400	g.	Fixing bath for films and plates
	Sodium hydrogen sulphite lye**	100	ml	
ORWO 304				
Rapid Fixing Bath	Sodium thiosulphate	200	g.	Rapid fixing bath for films and plates
	Ammonium chloride	50	g.	
	Potassium metabisulphite	20	g.	

* See footnote page 87.
** See footnote page 87.

Designation	Formula	Suitable as
ORWO 305 Hardening Fixing Bath	Sodium thiosulphate ..... 200 g. Sodium sulphite anhydrous ..... 20 g. Glacial acetic acid* ..... 15 ml Potash alum ..... 10 g. Dissolve chemicals in this sequence. Initial temperatue approx. 50 °C	Hardening bath for fixing films and plates under adverse climatic conditions
ORWO 306 Hardening Fixing Bath	Solution 1: Water ..... 400 ml Sodium thiosulphate ..... 280 g. Sodium sulphite anhydrous ..... 25 g. Concentrated sulphuric acid ..... 1.5 ml (Caution!) Solution 2: Water at approx. 45 °C ..... 300 ml chrome alum ..... 15 g. Pour solution 2 after cooling down, into solution 1 and top up to make 1 litre	Hardening fixing bath for films and plates under adverse climatic conditions
ORWO 308 Hardening Fixing Bath	Solution 1: Water ..... 400 ml Sodium thiosulphate ..... 340 g. Sodium sulphite, anhydrous ..... 17 g. Sodium hydrogen sulphite lye** ..... 100 ml Solution 2: Water at approx. 45 °C ..... 300 ml Chrom alum ..... 30 g. Pour solution 2, after cooling down, into solution 1 and top up to make 1 litre	Hardening fixing bath for cine machine processing

* See footnote page 87.
** See footnote page 87.

Designation	Formula	Suitable as

When **processing papers** it is recommended to rinse briefly **after fixing** and then to apply the following bath. This gives the paper felt an alkaline reaction, permitting the reduction of the final rinsing by $^1/_3$ and, furthermore, making it safer.

ORWO 320	sodium carbonate anhydrous	10 g.	processing time 2 to 3 minutes

It is difficult to state the utilization of this bath as it depends largely on the quantity of the carried-over fixing bath and its acidity. If the films are provided to drip off properly, it should be possible to process 100 prints of 9 x 12 cm in 1 litre of **ORWO 320**. To ensure perfect work, it is recommended to renew the bath more frequently, especially as it is relatively low-priced.

C 2 | ORWO Fixing-Salt Packs

ORWO Acid Fixing Salt A 300

Commercial Sizes: Packs of $^1/_{10}$ kg
¼ kg
1 kg
4½ kg

Dissolve contents in 8 times the quantity of water for films and plates, in 10 times the quantity for developing papers.

ORWO Rapid Fixing Salt A 304

Commercial Sizes: Packs of 80 g.
200 g.
800 g.

Dissolve in 5 times the quantity of water for plates and films and 7 to 8 times the quantit for developing papers.

ORWO X-Ray Hardening Fixing Bath A 309

Commercial Sizes: Packs for 4½ litres
9 litres
13½ litres

ORWO Acid X-Ray Fixing Salt A 310

Commercial Sizes: Packs for 9 litres
13½ litres

ORWO X-Ray Rapid Fixing Salt A 314

Commercial Sizes: Packs for 9 litres
13½ litres

ORWO Hardening Additive to Fixing Baths A 302

A 302 is a hardening agent, which is used for addition to the acid fixing bath to harden photographic papers, especially where high gloss is required. It provides the following advantages:

1. Greatest hardening effect, ensuring a reliable drying drum stability of all papers.
2. The fixing bath remains clear until exhaustion.
3. Great yield with regard to hardening effect.
4. Prevention of reduction of the highlights and the medium tones (corrosion).
5. Good maintenance of density during hot drying.

Commercial Sizes: Packs for 10 litres hardening fixing bath
50 litres hardening fixing bath

Substances in solid consistency (Part 1 and 2).

Instructions for Dissolving: Each pack contains two separate salt mixtures, 1 and 2, which should be added separately to the cooled ready-for-use acid fixing bath, whilst stirring thoroughly, and should be made to dissolve completely by agitating or stirring. In order to prevent the hardening fixing bath being excessively contaminated by the developer, it is recommended to rinse the prints thoroughly after developing, or to use instead of it a stop bath (**ORWO 200** or **ORWO 203**). If, in certain circumstances, an increased hardening effect is required, the added quantity of **A 302** may be increased to a maximum of double this amount.

Fixing time: 5 to 10 minutes. After fixing, thorough washing in the usual manner must be carried out.

D | ORWO Hardening-Bath Formulae

Designation	Formula		Processing time
ORWO 400			
for Paper	Potash alum powder	100 g.	5 to 10 minutes
	top up to 1 litre		
ORWO 401			
for Paper	40% formaldehyde	120 ml	5 to 10 minutes
	top up to 1 litre		
ORWO 402			
for Paper	40% formaldehyde	120 ml	5 to 10 minutes
	Alcohol	500 ml	especially strong
	top up to 1 litre		hardening
ORWO 405			
for Films and Plates	Chrome alum	15 g.	3 to 5 minutes
	Sodium sulphate anhydrous	75 g.	
	top up to 1 litre		
ORWO 406			
for Films and Plates	Chrome alum	15 g.	3 to 5 minutes
	Potassium metabisulphite	15 g.	
	top up to 1 litre		
ORWO 407			
for Cine negative Films	Chrome alum	50 g.	5 minutes
	top up to 1 litre		
ORWO 410			
for Films and Plates	Sodium sulphate anhydrous	150 g.	2 to 3 minutes
	Sodium carbonate anhydrous	20 g.	
	40% formaldehyde	20 ml	
	top up to 1 litre		
ORWO 412			
for Films and Plates	Sodium sulphate anhydrous	150 g.	2 to 3 minutes
	Potassium hydroxide	10 g.	
	40% formaldehyde	20 ml	
	top up to 1 litre		

ORWO 400 to 402 baths are intended for hardening **after fixing**. Under adverse climatic conditions, it is necessary to harden **after development**. For this purpose ORWO 405

to 407 Baths are suitable. A special hardening is achieved, when using strongly alkaline developers with the ORWO 410 Bath, when using caustic alkali developers with the ORWO 412 Bath.

Supplements

Designation	Formula	Processing Time

E | ORWO Toning Bath Formulae

Brown Toning

The brown toning of developing papers is, in principle, divided into two processes: "indirect" toning with previous bleaching, and "direct" toning in one process.

The photographs for toning must be developed and perfectly processed. The quality of the tone depends not only on the type of paper, but also on the used developers. In addition to ORWO **N 103** and **E 102** developers, each M-H developer may be used.

With the indirect toning method, the colour characteristic can be controlled between warm and cold brown shades by the selection of bleaching and toning baths.

Photographs processed in brown developers are unsuitable for brown toning methods.

The Indirect Toning Method

Method of Operation: The well-rinsed prints or enlargements are bleached, whereby the picture does not disappear completely; it remains slightly visible in brownish colour. After rinsing for approximately 10 minutes, toning can take place. It is extended until the print tone no longer changes. This is followed by another thorough rinsing.

Bleaching Baths

Designation	Formula		Processing Time
ORWO 500			
	Water	360 ml	Up to the disappearance of the black silver image
	Potassium cyanoferrate (III) 10% solution	600 ml	
	Potassium bromide 10% solution	40 ml	
ORWO 501			
	Water	400 ml	As above
	Potassium cyano-ferrate (III) 10% solution	500 ml	
	Potassium bromide 10% solution	100 ml	
ORWO 502			
	Water	190 ml	As above
	Potassium cyanoferrate (III) 10% solution	300 ml	As above
	Potassium bromide 10% solution	500 ml	
	Ammonia solution (spec. Gravity 0.91)	10 ml	
ORWO 503			
	Water	200 ml	As above
	Potassium cyanoferrate (III) 10% solution	500 ml	As above
	Potassium bromide 10% solution	100 ml	
	Sodium carbonate 10% solution	200 ml	

Toning Baths

Designation	Formula		Processing Time
ORWO 510			
	Sodium sulphide crystalline	5 g.	½ to 1 minute
	top up to 1 litre		
ORWO 516			
	Water	100 ml	½ to 1 minute
	Sodium sulphide crystalline	40 g.	
	Selenium (amorphous)	1 g.	
	For use dilute 1 part of solution with 30 parts of water		

Designation	Formula		Processing Time
ORWO 520			
	Water	500 ml	½ to 1 minute
	thiourea 5% solution	100 ml	
	Potassium bromide 10% solution	400 ml	
	Sodium hydroxide 10% solution	30 ml	
ORWO 525			
	Water	500 ml	½ to 1 minute
	thiourea 5% solution	100 ml	
	Potassium bromide 10% solution	400 ml	
	Sodium hydroxide 10% solution	150 ml	

When using the toning baths ORWO 520 and 525, the prints must be bathed prior to bleaching in the bleaching bath ORWO 503 for two minutes in 2% of acetic acid. Subsequently, they should be thoroughly rinsed. After bleaching, rinsing is carried out as usual. The toning bath may have a temperature of 18 °C to 25 °C. When standing for a longer time in an open dish, the effect of the toning baths ORWO 520 and 525 is reduced. The toning baths may be regenerated by adding sodium hydroxide solution, as follows:

20 ml 10% sodium hydroxide solution for ORWO 520
100 ml 10% sodium hydroxide solution for ORWO 525

Designation	Formula		Processing Time
ORWO 527			
	Water	800 ml	½ to 1 minute
	Sodium thioantimonate (shlippe's salt)	10 g.	
	Sodium carbonate anhydrous 10% solution	30 ml	
	Sodium bromide 10% solution	160 ml	

By adding a further 30 to 100 ml sodium carbonate solution, the reddish-brown tone can be shifted towards brown.

The Direct Toning Method

Method of operation: After thorough rinsing, the photographs are placed immediately into the toning baths and are treated until they have acquired the desired sepia tone. Subsequent rinsing is carried out as usual.

Designation	Formula	Processing Time
ORWO 518		
Hot Sulphur Toning	Sodium thiosulphate crystalline .... 200 g. Potash alum ..... 40 g. Silver nitrate ..... 0.5 g. top up to 1 litre	3 to 15 minutes

Instructions for Dissolving: The sodium thiosulphate is dissolved in 750 ml of water, by heating to 50 °C. Subsequently, the potash alum is added whilst stirring and also completely dissolved. (This causes foaming and the generation of a weak odour of sulphurous acid and hydrogen sulphide, whilst a white sulphur deposit is separated.) The silver nitrate is dissolved in 10 ml of water and then added to the solution. Finally water is added to make up 1 litre.

Instructions for Processing: The toning bath is ready for use only after some hours and must have an initial temperature of 40 to 50 °C. During toning, which according to the processed type of paper, takes 3 to 15 minutes, the temperature is increased to 55 °C. The deposit formed in the toning bath must not be poured away. After previous shaking it should also be put into the dish.

Papers, the coating of which becomes soft due to the high temperature of the bath, should be hardened beforehand in a 10% potash alum solution for 10 minutes.

The sulphur sludge despositing on the photographs during toning can be washed off from the front and back of the prints, during rinsing, with a small cotton wool tampon. Final rinsing approximately 20 minutes.

Reddish Toning

Designation	Formula	Processing Time
ORWO 530		
Gold-toning Bath	Water ..... 1000 ml Auric chloride 2% solution ..... 55 ml Thiourea 5% solution ..... 55 ml	According to the required tone

Reddish tones in the most varied gradation are obtained, especially with photographs on a white base, which have already been toned brown, according to the indirect method.

Blue Toning

When using the same bath as for the reddish toning, ORWO 530, a blue-tinged silver image is obtained on untoned, black-developed prints and especially on untoned brown-developed prints. For pure blue tones, the following iron-toning bath is particularly suitable:

Designation	Formula	Processing Time
ORWO 536		
Iron-blue Toning Bath	Solution 1: Water ..... 330 ml Potassium cyanoferrate (III) 10% solution ..... 50 ml Ammonium sodium hydrogen phosphate 10% solution ..... 120 ml Solution 2: Water ..... 100 ml Potash alum 10% solution ..... 100 ml Iron alum 10% solution ..... 60 ml Sodium hydrogen sulphate 10% solution ..... 240 ml	1 to 2 minutes

For use, two parts of water are mixed with 1 part each of 1 and 2. The stock solutions should not be used when they are quite fresh.

Caution! Danger of formation of free hydrocyanic acid by decomposition of the potassium cyanoferrate in the acid range. The toning of well-fixed and well-rinsed photographs, which have not been developed too strongly, must not be carried out in excessively bright daylight. After toning, the photographs should be bathed for ½ minute in a 1% sodium tetraborate solution and subsequently rinsed for 20 minutes. To avoid drying stain, water drops should be removed from the emulsion, prior to drying.

F 1 | ORWO Intensifier Formulae

Designation	Formula		Processing Time
ORWO 600 Silver Intensifier	Solution 1:		
	Distilled water	1 litre	As required
	ORWO H 142	3 g.	
	Citric acid	3 g.	
	Solution 2:		
	Distilled water	100 ml	
	Silver nitrate	5 g.	
	For use mix 100 ml of 1 with 10 ml of 2. The mixture is not stable.		
	After intensifying, the negative is briefly rinsed, and subsequently processed for 2 minutes in a fresh acid fixing bath. Finally, it is well rinsed.		
ORWO 601 Mercuric Chloride Intensifier	Solution I:		
	water	100 ml	As required
	mercuric chloride	2 g.	
	Solution II:		
	Water	100 ml	
	Ammonia solution (specific gravity 0,91)	10 ml	
	The negative should be processed in solution 1 until it appears quite white. Then it is rinsed for approximately 20 minutes and subsequently processed in solution II until the negative is absolutely dense. The density may also be achieved with a 5% sodium sulphite solution, or with an M-H developer. Subsequently rinse briefly.		
ORWO 602 Mercury Bromide Intensifier	Solution I:		
	Water	100 ml	As required
	Potassium bromide	2 g.	
	Mercuric chloride	2 g.	
	Solution II:		
	see under ORWO 601 Process as described under ORWO 601.		

Designation	Formula		Processing Time
ORWO 603			
	Water	235 ml	As required
Mercuric-iodide Intensifier	Mercuric chloride 2% solution	100 ml	
	Potassium iodide 10% solution	25 ml	
	Sodium thiosulphate 10% solution	40 ml	

Attention! When adding mercuric chloride and potassium iodide solutions to the water, a red precipitation occurs, which again disappears on the addition of thiosulphate solution.

ORWO 604

	Solution 1:		As required
Uranium Intensifier	Water	100 ml	
	Uranyl nitrate	1 g.	
	Glacial acetic acid	10 ml	
	Solution 2:		
	Water	100 ml	
	Potassium cyanoferrate (III)	1 g.	

For use, mix 1 and 2 in equal parts. The negatives to be intensified should be processed in this solution until they have the requisite density. Subsequently rinsing is carried out until the water runs off uniformly from the emulsion. The intensification gives the negative a yellow to reddish-brown colour.

ORWO Copper Intensifier A 605

Agent for the re-treatment of slightly underexposed, too weak negatives. Tubes for 200 ml.

Method of Operation: The contents of the tube are dissolved in 200 ml of water at 18 to 20 °C. The intensifier must be used immediately as the solution remains stable for 30 minutes only.

The processing time depends on the required degree of intensification and is 3 to 5 minutes. Prior to processing the negatives, good rinsing should be ensured. The negatives are placed into the bath when damp. They assume a copper-brown colour, the grain getting slightly larger. Finally, the negatives are rinsed in the usual manner.

G 1 | OB WO Reducer Formulae

Designation	Formula		Processing Time
OB WO 700 Reducer for Reproduction Material	Solution 1:		
	Sodium thiosulphate	150 g.	As required
	Thiourea	12 g.	
	Water to make up	1 litre	
	Solution 2:		
	Potassium cyanoferrate (III)	20 g.	
	Water to make up	1 litre	
	Shortly before use, mix 1 and 2 in equal parts. The negatives become harder through reduction.		
OB WO 700a Adjustable Reducer for Repro-material	Solution 1:		
	Sodium thiosulphate	150 g.	As required
	Thiourea	12 g.	
	Water to make up	1 litre	
	Solution 2:		
	Potassium cyanoferrate (III)	50 g.	
	Water to make up	1 litre	
	The speed of the caustic effect may be adjusted through different mixing ratios with water.		
	For use the following quantities are mixed:		

Caustic Effect	Solution 1	Solution 2	Water
rapid	1 part	1 part	—
medium	1 part	1 part	2 parts
slow	1 part	1 part	4 parts

OB WO 701 Persulphate Reducer after Andresen	Distilled water	100 ml	3 to 4 minutes
	Ammonium persulphate	5 g.	
	Ammonia solution (specific gravity 0.91)	4 ml	
	Sodium chloride	2 g.	
	Sodium thiosulphate	*25 g.	
	Works slower than other persulphate reducers and has a greater effect on fog and threshold		

Designation	Formula		Processing Time
SW 702			
	Distilled water	100 ml	4 to 5 minutes
Benzoquinone Reducer	Benzoquinone	¼ g.	
	Sulphuric acid conc. (Caution!)	3 ml	
	Prior and subsequent to reducing, rinse thoroughly. The negatives become softer.		
SW 704			
Potassium Bichromate reducer	water	1 litre	5 to 10 minutes as required
	Potassium bichromate	1 g.	
	Sulphuric acid conc. (Caution!)	2 ml	
	For use dilute with water 1:1. After processing rinse briefly and clear in fresh acid fixing bath. Subsequently rinse for 15 minutes.		
SW 706			
Potassium Permanganate Reducer	Water	1 litre	5 to 10 minutes
	Potassium permanganate	2 g.	As required
	Rinse briefly after processing and clear in a fresh acid fixing bath until the brownish colour has disappeared. Subsequently rinse for 15 minutes.		
SW 707			
Potassium Permanganate Reducer	Water	1 litre	2 to 5 minutes
	Potash alum	50 g.	As required
	Potassium permanganate	0.5 g.	
	For use dilute with water 1:1. After processing, rinse briefly and clear in a fresh acid fixing bath until the brownish colour has disappeared. Subsequently rinse for 15 minutes.		
SW 708			
Potassium Permanganate Reducer	Water	1 litre	2 to 5 minutes as required
	Potassium-permanganate	1 g.	
	Sulphuric acid conc. (Caution!)	5 ml	
	For use dilute with water 1:10. After processing, rinse briefly and clearin a fresh acid fixing bath until the brownish colour has disappeared. Subsequently rinse for 15 minutes.		

Designation	Formula		Processing Time
SW 710			
Reducer (Fine Grain Re-developer)	Solution I: Bleaching Bath		
	Water	800 ml	
	Copper sulphate crystalline	100 g.	
	Sodium chloride	100 g.	
	Sulphuric acid conc. (Caution!)	25 ml	
	make up to 1 litre		
	Solution II: Re-developer		
	p-Phenylene diamine hydrochloric acid	3 g.	
	Sodium sulphite anhydrous	20 g.	
	make up to 1 litre		
	The negatives are bleached in bath 1 until the densities have become bright. Then rinsing is continued until the blue disappears.		
	Subsequently re-develop in bath II in the bright light until the requisite density is obtained. (3 to 5 minutes) and fix in an acid fixing bath. Final rinsing 15 minutes.		
	For re-developing other fine grain developers are also suitable, such as ORWO A 49 diluted 1:2 (3 to 5 minutes).		
SW 711			
Reducer (Iron Blue Toner)	Solution 1:		
	Water	1 litre	Until complete blue toning (approx. 5 to 10 minutes)
	Potassium cyanoferrate (III)	10 g.	
	Potassium bichromate 1% solution	1.3 ml	
	Solution 2:		
	Water	1 litre	
	Ferric alum crystalline	21.2 g.	
	Solution 3:		
	Water	1 litre	
	Oxalic acid crystalline	50 g.	
	Mix equal parts of 1, 2 and 3 in attenuated light. After reduction, which is only a conversion of the silver image into an iron-blue image, rinse briefly. Subsequently process in 3% neutral fixing bath. Final rinsing 15 minutes. The processed negatives result in considerably softer prints and enlargements with a clear fine grain and permit a greater reduction in the exposure time.		

ORWO Reducer (after Farmer) A 700

Agent for the subsequent treatment of negatives and transparencies.
Tubes for 200 ml.

Method of Working

For Negatives: The contents of the tube are dissolved in 200 ml of water at 18 to 20 °C. The reducer must be used immediately as the solution has a stability of 30 minutes only.

The processing time depends on the density of the negatives, which are soaked beforehand, amount to 3 to 10 minutes. The negatives not only become thinner, but also somewhat harder. After reduction, rinsing is carried out, then short fixing and subsequently rinsing.

For transparancies: the contents of the tube are dissolved in 300 ml of water at 18 to 20 °C, and must be used immediately, as the reducer has a stability of 30 minutes only. Transparancies as a rule require only a short clearing, which can be achieved with this diluted solution in ½ to 2 minutes only. If a partial reduction is to be carried out, it is recommended to dilute the solution still further. Subsequently rinsing is carried out, short fixing and rinsing.

H 1 | ORWO Reversal-Development Black-and-White Processing Solutions from Formulae

The reversal development black-and-white has its main importance in the field of the substandard film, but is also used for miniature films. The nature of black-and-white reversal development will be explained later, in connection with the ORWO-COLOR reversal development (see pages 132, 133) and is explained with diagrams.

The processing of reversal films is carried out primarily in developing laboratories, but can also be made in self-prepared solutions. Packs in various sizes, ready for use, contain the requisite chemicals in a convenient form. (See pages 115 to 117.) There is, however, also the possibility of preparing the requisite baths from individual chemicals, according to the following formulae:

Designation	Formula			Processing Time
ORWO 825				
Preliminary Bath	Water	1	litre	2 to 3 minutes at 19 °C
	ORWO-Desensitizer D 903	0.5	g.	
	"Raschit" dissolve in 5 ml of alcohol and add in a thin jet (stir vigorously)	0.25	g.	
ORWO 826				
First-Developer for Black-and-White Reversal Film	Solution A:			
	Water at approx. 35 °C	750.	ml	12 minutes at 19 °C
	ORWO Anti-Lime Agent A 901	2	g.	
	ORWO M 143	2	g.	
	Sodium sulphite anhydrous	25	g.	
	ORWO H 142	14	g.	
	Potassium bromide	2	g.	
	Potassium carbonate	40	g.	
	Sodium sulphate anhydrous	10	g.	
	Solution B:			
	Water at approx. 20 °C	125	ml	
	Sodium hydroxide	2	g.	
	Pour solution B into the cooled-down solution A, dissolve in this mixture: potassium thiocyanate	2.5	g.	
	and subsequently top up to 1 litre			

Designation	Formula		Processing Time
ORWO 826 R			
Regenerator for ORWO 826	Solution A:		
	Water at approx. 35 °C	750 ml	Not to be used as a developer on its own
	ORWO Anti-Lime Agent A 901	2 g.	
	ORWO M 143	4 g.	
	Sodium sulphite anhydrous	50 g.	
	ORWO H 142	28 g.	
	Potassium carbonate	80 g.	
	Sodium sulphate anhydrous	20 g.	
	Solution B:		
	Water at approx. 20 °C	125 ml	
	Sodium hydroxide	4 g.	
	pour solution B into cooled-down solution A and dissolve in this mixture:		
	Potassium thiocyanate	5 g.	
	and subsequently top up to 1 litre		
ORWO 830			
Reversal Bath for Black-and-White Reversal Film	Water	1 litre	3 to 5 minutes at 19 °C
	Potassium bichromate	5 g.	
	Sulphuric acid conc. (Caution!)	5 ml	
	or sodium hydrogen sulphate, crystalline	25 g.	
ORWO 831			
Clearing Bath for Black-and-White Reversal Film	Water	750 ml	5 to 7 minutes at 19 °C
	ORWO Anti-Lime Agent A 901	1 g.	
	Sodium sulphite anhydrous	50 g.	
	top up to 1 litre		

Supplements

H 2 | ORWO Black-and-White Reversal Development

Processing Solution from Ready-for-Use Packs

Developer Set 600 ml

Convenient assortment of chemicals for preparing solutions which are required especially for processing ORWO Reversal films in the developing box.

Commercial Size: Small packs for 600 ml each.

The solid substances for the five required solutions are compiles as units, the safe differentiation of which is ensured by inscriptions in different colours.

Blue Inscription	First Developer	**A 826**	4 parts
Green Inscription	Reversal Bath	**A 830**	2 parts
Black Inscription	Clearing Bath	**A 831**	1 part
Orange Inscription	Second Developer	**A 841**	2 parts
Red Inscription	Fixing Bath	**A 850**	1 part

Instructions for Dissolving

First Developer A 826:

Dissolve parts A and B one after the other in 450 ml of water at approximately 35 °C. Part C is dissolved separately in 75 ml of water at approximately 20 °C and then added to the first solution which has in the meantime cooled down to 20 °C. Finally, Part D is added to this mixture, and after dissolving, water is added to make up to 600 ml.

Reversal Bath A 830: Parts 1 and 2 are completely dissolved one after the other in 500 ml of water and then water is added to make up 600 ml.

Clearing Bath A 831: The contents of the bottle with the black marking are dissolved in 500 ml of water, and subsequently water is added to make up 600 ml.

Second Developer A 841: Part A is dissolved in 500 ml of water at approximately 35 °C. Subsequently Part B is added in small portions, also dissolved and topped up with water to make 600 ml.

Fixing Bath A 850: The contents of the bottle with the red inscription are dissolved in 600 ml of water.

35 Litres Packs

Chemicals for producing solutions, which are required for processing ORWO-Reversal films in larger quantities.

Commercial Sizes: Packs for 35 litres each.

The solid substances for the five required solutions are compiled in units, consisting of a different number of parts.

First Developer	**A 826**	4 parts
Reversal Bath	**A 830**	2 parts
Clearing Bath	**A 831**	1 part
Second Developer	**A 841**	2 parts
Fixing Bath	**A 850**	1 part

Instructions for Dissolving

First Developer A 826:

Part A } dissolve one after the other in .... 25 litres of water at 35 °C
Part B }

Part C to be dissolved separately in ..... 3 litres of water at 20 °C and pour into the first solution which has in the meantime cooled down to 20 °C.

Part D is finally added to this mixture and, after dissolving, is topped up with water to the final volume of ..... 35 litres.

Reversal Bath A 830:

Part 1 is dissolved in ..... 30 litres of water
Part 2 is subsequently added and also completely dissolved. Water is then added to make up the final volume of ..... 35 litres.

Clearing Bath A 831:

Dissolve contents of package in..... 30 litres of water top up with water to the final volume of ..... 35 litres.

Second Developer A 841:

Dissolve Part A in ..... 30 litres of water at 35 °C
Subsequently pour in Part B in small portions. After dissolving, top up with water to the final volume of ..... 35 litres.

Fixing Bath A 850:

Dissolve contents of pack in ..... 35 litres of water

Regenerator A 826 R for First Developer A 826 for Black-and-white Reversal Film

The prepared regenerator solution must not be used as a developer on its own, but only according to the instructions for use.

Commercial Size: Pack for 5 litres.

The solid substances are packed in 4 Parts.

Instructions for Dissolving: Part A and B are dissolved one after the other in 4 litres of water at 35 °C.

Dissolve part C separately in 0.4 litres of water at 20 °C and pour into the first solution, which has in the meantime cooled to 20 °C.
Finally part D is added to the mixture and after dissolving, is topped up with water to the final volume.

Instructions for Use: See page 120.

H 3 | ORWO Black-and-White Reversal Development
Processing

ORWO **Reversal Substandard Films**

ORWO **Reversal Miniature Films**

ORWO **Television Reversal Films**

ORWO **Reversal Print Films**

Process	Processing Solution after Formulas	Processing Solution from Packs	Processing Time at 19 °C
1. Preliminary Bath*	ORWO 825		2 to 3 minutes
2. First Development	ORWO 826	First Developer A 826	12 minutes
3. Intermediate Rinsing			10 minutes
4. Reverse	ORWO 830	Reversal Bath A 830	3 to 5 minutes
5. Intermediate Rinsing			5 minutes
6. Clearing	ORWO 831	Clearing Bath A 831	5 to 7 minutes
7. Intermediate Rinsing			5 minutes
8. Second Exposure**			5 minutes
9. Second Development	ORWO 1 (s. p. 31)	Second Developer A 841	6 to 8 minutes
10. Intermediate Rinsing			1 minute
11. Fixing	ORWO 300 or ORWO 303 (s. p. 89)	Fixing Bath A 850	5 minutes
12. Final Rinsing			30 minutes

* The components of the preliminary bath are not obtainable as ORWO packs. The application is required only in rare cases. If, under certain conditions, during processing, white spots occur, they can be obviated by the preliminary bath ORWO 825.

** See notes, pages 119/120.

12 minutes are specified for the first development of normally exposed films. Underexposed films can be developed longer, but the maximum is 3 minutes. For overexposed photographs, a small compensation by reducing development to 9 minutes is possible.

Perfect results in reversal development can only be expected when not only the general instructions for use are observed, but also the following hints: Basically, increased cleanliness should be ensured. A contamination of solutions and reciprocal soiling of the baths must be avoided.

The number of baths involved in reversal development necessitates efficient maintenance of the working implements. (Developing box, insert, developing frame.)

Advices for Processing Small Quantities

Processing in the baths is carried out under moderate agitation of the box insert. Rinsing processes are carried out, preferably in somewhat larger containers, under running water, whilst moving the insert up and down several times.

For the second exposure, the film must be removed from the insert. By using a 100 watt lamp at a distance of 100 cm, the film is exposed for 5 minutes from the emulsion side. The following part of the working process is carried out in bright light.

The specified processing times apply to ORWO-Reversal-Miniature Film **UP 15**. If other single emulsion layer films of lower speed and steep gradation are to be subjected to a reversal processing, first and second development times should be adjusted to the respective types of films.

Stability and Utilization

A stability of 4 weeks can be expected for solutions when they are always returned into brown bottles, filled up to the brim and closed airtight. Five miniature films can be perfectly processed in solutions of the ORWO Reversal Developer Set.

Advice on Processing Large Quantities (Tank, Machine)

Processing in baths is carried out using certain methods of agitation. In the first developer, the frames are agitated moderately. In the other baths and in the rinsing processes, it is sufficient to lift them out several times to half the height of the frame, at the beginning of processing.

Before commencing work, it is recommended to remove any oxidation foam from the surface of the developer, by wiping with filter paper. During intervals in work, the solutions should be protected from the access of air, preferably by floating covers.

Second exposure is carried out with two lamps of 100 to 150 watts each. At a distance of 1½ to 2 metres, exposure is carried out from the emulsion side for 5 minutes.

The uniformity of the development can best be inspected by a test strip. For this purpose, a strip of substandard film is exposed under the same conditions and cuts are developed from time to time.

Life and Utilization

When applying reversal development on a larger scale, possibly in tanks with a capacity of 35 to 70 litres, it is possible to obtain a utilization of the solutions for a prolonged time by regeneration. The following points should be observed when processing 16 mm substandard films, with regard to individual solutions of a 70 litre tank system:

First Developer A 826: After an output of, for example, 500 metres daily, 3 litres of regenerator solution should be added to the tank filling (s. p. 117), and furthermore, fresh developer should be added to the initial level. If more than 500 metres are developed in one day, 1 litre of regenerator solution should be added for a further 150 metres. In this manner, it is possible to develop 12,000 metres in constant quality during 4 weeks. If the same output of substandard film strip already achieved beforehand, the tank filling must also be removed sooner. It must not be used under any circumstances for longer than 4 weeks. If no development is carried out on one day, regeneration with regenerator must be carried out, nevertheless, removing 3 litres of developer beforehand from the tank.

Reversal Bath A 830: The efficiency of the reversal bath remains instant, when the solution carried away is replaced by a fresh reversal bath. In one tank filling, however, only approximately 1,500 metres can be processed with a maximum life of the reversal bath of 4 weeks.

Clearing Bath A 831: Also here, as with the reversal bath, any carried-away solution is simply replaced by a fresh clearing bath to maintain the efficiency. Utilization is also only 1,500 metres.

Second Developer A 841: Assuming a quantity of 500 metres daily, which we took as a basis for the first developer, the contents of the tank require a daily refilling of 2½ litres of fresh second developer. In this manner, a throughput of 12,000 metres of 16 mm substandard film is possible within 4 weeks, this being regarded as the life span of the second developer.

Fixing Bath A 850: The utilization of the fixing bath is 12,000 metres with a life of 2 weeks. In this case 5 litres of fresh fixing bath must be added daily. In order to keep the tank contents constant to 70 litres, it is required to remove the corresponding quantity of fixing bath beforehand.

ORWO Anti-Lime Agent A 901

Agent for preventing lime deposits when using tap water for preparing developers. Packs of 100 gr.

Our tap water contains certain quantities of calcium and magnesium compounds which essentially determine the hardness of the water. The housewife knows that lime salts have a detrimental effect on cooking and washing (deposit of "fur" in pots, high consumption of soap because of the formation of lime soap depositing flakes). On the other hand, the removal of minerals from drinking water at the water works is not allowed as these are required for the human body. Those engaged in photography are also confronted with the fact that tap water contains a certain quantity of lime salts. When, for instance, a developer is prepared from individual chemicals, lime deposits occur on adding alkalis to the water, and lime fog, which can be removed only by an acid bath (2% acetic acid), may form on the developed negatives.

Most of the ready-prepared solid developers, such as ORWO **F 43**, ORWO, **A 49**, etc. contain an anti-lime additive, thus preventing precipitation, with normal water hardness. By using ORWO Anti-Lime Agent **A 901**, it is also possible to avoid a deposit when preparing developers oneself from individual chemicals. This applies to black-and-white, as well as to ORWOCOLOR processing baths.

It is necessary when using **A 901** neither beforehand to boil the water used for self-preparation from individual chemicals, nor to clean it by adding alkalis or an ion-exchanger (Wofatit), nor even to filter away the deposit forming in the preparation of the developer.

ORWO **A 901** should be added before the other developer chemicals and forms complex compounds with the salts in the water, these are not destroyed by adding alkali and, therefore, do not result in precipitation.

For softening 1 litre of water with 1 °dH, approximately 0.20 g. **A 901** is required, so that, with medium-hard tap water of 10 °dH, approximately 2 g. per litre will suffice.

Where it is necessary, for instance, to prepare a developer according to formula ORWO 20, 2 gr. of ORWO Anti-Lime Agent **A 901** should be added for each litre, before adding the other substances. Ready-for-use liquid developers such as ORWO **E 102**, have a tendency to lime precipitations when using tap water. **A 901** provides the remedy in this instance as well, if the above described procedure is followed.

Even with ready-for-use fixed developers, it is possible that **A 901** will be required for very hard water. According to the degree of hardness, 1 to 2 g. anti-lime agent per litre of water is dissolved prior to the developer substance.

ORWO Tank Balls A 902

Preserving agents for tank developers.

Box containing 4 pieces.

ORWO Tank Balls have the task of preventing decompositions in tank developers in prolonged use. They have no influence on the developing properties of the developers. They simpley improve the stability of the tank developers. This favourable effect is particularly noticeable during the summer months, or when working in a hotter climate.
A tank ball cannot be used for developers in which papers are also processed.

Method of Use: The balls are added to the developer solution in the tank: 4 pieces to a 70 litre tank. As a result of their own weight, they sink to the bottom screen of the tank and remain there. The balls do not dissolve and do not decompose. The developer dissolves from the balls their maximum-efficiency preserving substance only in the very small quantity sufficient entirely to prevent decomposition and the consequent occurrence of an unpleasant odour. Even after many months the balls do not lose their efficiency. It is, however, recommended to use fresh tank water when preparing new developer solution.

ORWO Desensitizer D 903

Desensitizer **D 903** reduces the sensitivity of photographic materials, especially with regard to light of a longer wavelength, so that it is possible to process in bright yellow-green light. It can be added to all developers, except to ORWO special negative developer **N 02**.
Packs with 5 tablets are available.

Method of Working

Dissolving: One tablet, preferably broken into pieces, is dissolved in approximately 30 ml of warm water. The solution, which still looks turbidly is poured into 500 ml of ready-for-use developer. The aqueous suspension of **D 903** keeps for a long time and can be prepared as a stock solution.

Darkroom Illumination: The developer, mixed with desensitizer, is used first to develop for 3 minutes in the dark (or, in the case of panchromatic material, with darkroom safelight screen No. 108; for orthochromatic material, with darkroom safelight screen No. 107); subsequently the brighter illumination is switched on. Maximum-speed films are also compatible with the direct light of the yellow-green darkroom safelight screen No. 113 D. The distance of the film from the darkroom lamp should be at least 75 cm. (15 watt bulb).

Note

Like most desensitizers, **D 903** also has a slightly retarding effect on development. This should be taken into consideration, either when exposing, by opening the aperture half a step further than usual, or by developing for a slightly longer time than would be required for the respective type of film without desensitizer.
Adequate final rinsing of the film should be ensured to avoid yellow coloration.

ORWO Re-Touching Dyestuff N 904

Agent for dyeing insufficiently dense parts of negatives.
Glass tubes containing 5 gr. of dyestuff.

Method of Use: ORWO **N 904** is a red dyestuff in powder form, readily soluble in water. The solution is used for dyeing insufficiently dense parts of negatives, which result in a particularly dark positive, when, in the interest of the entire image impression, no correspondingly soft paper gradation can be used. When applying with the brush, a thin solution should first be taken, which produces just a slight reddish colouring. This process is repeated, if necessary, with an even stronger solution, until the dyed part provides the required density on printing. **N 904** can be removed simply by washing the negative.

ORWO Wetting Agent F 905

Highly-concentrated wetting agent for black-and-white and ORWOCOLOR materials.
Bottles of ¼ and 1 litre.

ORWO **F 905** contains a surface-active substance. This reduces the surface tension of the water, thus achieving a good wetting effect.

Method of Working

1. In a dilution of 5 ml to 1 litre of water, with a bath time of 30 to 60 seconds and subsequent to final rinsing of plates, films and photographic paper, the solution ensures a smooth running-off of the water and, thus, a speedy, uniform and spotless drying. It facilitates the obtaining of high gloss when drying photographic papers. Should a slight coating form after drying on films without backing, this can easily be wiped off with a cloth.

2. In the same dilution and at the same time, as an intermediate bath, prior to second exposure of reversal films F 905 prevents the formation of water drops. ORWOCOLOR reversal films, thus, remain free from "red rings".

3. The wetting effect of photographic baths is increased by adding 2 ml of F 905 to 1 litre of solution. With the wetting agent, however, the lathering effect is also increased, so that care should be taken, especially with box developments. To avoid colour falsification, not more than 1 ml of F 905 per litre should be added to ORWOCOLOR First Developer C 09.

Utilization: The yield of the wetting-agent solution depends on the quantity of water, which is carried in during work. If "islets" form on the surface of the treated materials the bath must be renewed. When removing from it films and papers should, therefore, always be uniformly wetted with liquid.

It is possible in 1 litre **F 905** (1:200) to process at least 200 paper prints 18 cm × 24 cm, or 20 miniature or roll films.

ORWO Substandard Film Cement A 960

Adhesive for developed films.
Bottles with 750 g. of solution.

ORWO Substandard Film Cement A 961

New type of adhesive for black-and-white and colour film.
Bottles with 10 g. solution.

ORWO Adhesive A 962

Especially for developed and non-developed cine-safety film.
Bottles with 750 g. of solution.

Methods of Operation for Adhesives A 960, A 961 and A 962: Prior to coating the film ends to be stuck with the adhesive, the emulsion coat must be carefully removed and both sides made slightly rough. Dampening with the adhesive cement must be carried out with great care. The splice should be kept for at least one minute under pressure in the splicer.
Adhesives are combustible. To avoid evaporation, bottles should always be kept well closed.

ORWO Adhesive A 970

For cementing magnetic tapes.
Bottles with 20 ml and 100 ml of solution.

Method of Operation: The tape-ends to be joined are cut off straight and are stuck for about 10 mm one on top of the other. The emulsion side of the one tape is dampened for this purpose with a glass rod with adhesive. After fitting the other end of the tape on to it, the splice is held for a while between two fingers.
Then the excess adhesive is wiped off and the splice wound immediately on to the roll, as it could otherwise warp.
No cement must fall upon the roll of tape, as otherwise the various windings might stick together.
The bottle should be kept well closed to avoid evaporation.
A 970 is combustible.

ORWO Repro Film Cementing Varnish A 980

Bottles with 750 g. of solution.

Method of Operation: Film cementing varnish serves to keep the phototechnical film flat in the cassette during exposure. This is achieved by rolling the film in the darkroom on to a glass plate, prepared with this cementing varnish. The cementing varnish, poured on to a clean glass plate of suitable size, in the same manner as collodion or matt varnish, is applied and the excessive varnish is allowed to flow back over a corner of the plate into a separate bottle. The adhesive coat forming on the glass plate may be used after approximately half an hour of standing in an atmosphere which should be as free as possible from dust. In the darkroom, the requisite piece of film can then be rolled cleanly and smoothly on to the glass plate with a roller squeezer, whereby it should be ensured that one corner of the film is bent upwards, so that the film may easily be pulled off from the glass plate after exposure. The glass plate with the film stuck-on is inserted into the cassette just as a standard phototechnical plate. The adhesive plate may be used repeatedly and for a long time, if protected from dust or drying-out when not in use by placing loosely on uncoated film.
It is important for the adhesive varnish to be streod at the most uniformly possible room temperature and for it also to be used at such a temperature; at low temperatures the adhesive power is no longer as good. If an adhesive plate is no longer suitable for use after prolonged application, the adhesive varnish may be washed off with carbon tetrachloride or benzene, and the glass plate newly coated.

A 908 ist combustible.

J 2 | ORWO Auxiliary Mean Formulae

Designation	Formula	
ORWO 960	Washed-off safety film	13.5 g.
Substandard Film Cement	Acetone	337.5 g.
	Glacial acetic acid	112.5 g.
	Camphor	45.0 g.
	Triphenyl phosphate	2.5 g.
	Phthalic acid dimethylester	48.5 g.
ORWO 962	Washed-off safety film	1 g.
Adhesive for	Acetone	30 g.
Cine-safety Film	Methylenechloride	30 g.
	Methyl glycol acetate	30 g.
	Phthalic acid dimethylester	10 g.
ORWO 970	Methyl acetate	70 g.
Adhesive for Magnetic Tapes	Methyl glycol acetate (or methyl glycol)	30 g.
ORWO 990	Acetone	20 g.
Polishing and Matt-treatment	Ether	30 g.
Agent for Safety Film	Methanol	10 g.

K1 | The ORWOCOLOR Method

During the first century of photography, the results of photographic processes were mostly single-coloured, in the terms of gradation: white-grey-black. On passing into the second century, there were methods permitting the entire colour scale of nature to be imaged in a simple manner. These methods culminate to day in a reasonable technical expenditure and good results.
With ORWOCOLOR materials, we have the possibility of making colour exposures in film with every camera, without additional devices, and of coloured reproduction on film paper.
ORWOCOLOR films and papers have a structure considerably different from that of black-and-white materials. Three individual layers one on top of the other, in addition to the light sensitive silver-salts, contain those organic substances of a different nature (sensitizers, components or colour couplers) which control light-sensitivity and colour-formation capacity individually in such a manner that, after colour development, a picture is obtained by subtractive colour mixing, which is true in colour rendering and free from silver.

The Simplest Way: ORWOCOLOR Reversal Film

From a historic point of view, the reversal film was the first to be produced, this, after exposure and immediately upon reversal development supplied a bright coloured positive; as substandard film for projection, as miniature-, roll- and sheet film and also for direct viewing.

The ORWOCOLOR Negative-Positive Method is more versatile

It takes place in two stages and produces first a complementary coloured negative, with different potentialities for producing coloured positives.
When using ORWOCOLOR positive films, there result true-tonature transparencies for the most varied purposes. In this manner, films for the cinema are produced as

copies. Miniature-, roll- and sheet films may also be copied, and enlarged and are theu suitable for projection or for the viewer. For this purpose, the smaller sizes are probably reserved for those photographs for personal souvenirs; they are used, however, nowadays to an increasing extent, for teaching purposes and viewing material to enliven teaching. The medium and large sizes are gaining in importance for advertising, because the brightness of the transmitted colours provides advertising ideas with a valuable adjunct.

The Coloured Paper Print

The use of ORWOCOLOR paper, on the other hand, produces photographs for direct viewing in the same size or enlarged. ORWOCOLOR positive methods require colour control of the light for printing and enlarging equipment. A suitably coloured light is obtained by control foils and copying filters, yellow-magenta-cyan, in varying compoundings and varying density, which, with the specific negative and the use for ORWOCOLOR positive film, or ORWOCOLOR paper, results in well-adjusted positives.
In addition to the choice of size, the negative-positive method, as compared to the reversal method, also has the advantage that no numerical limitation of positives exists. The disadvantage of reversal films, hitherto, has been that only individual pieces could be produced. This is now eliminated, as, with ORWOCOLOR reversal print film and paper, we have the possibility of making any number of colour-positive duplicates required without an intermediate negative.

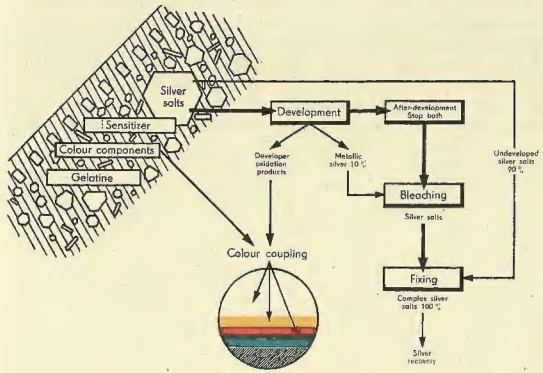
Processing

The processing of ORWOCOLOR material is in itself not too complicated. Guaranteed success can only be ensure, however, if the basic requirements of each photographic activity are fulfilled. The maintenance of extreme cleanliness; the checking of the bath temperatures and processing times. The material expenditure is only worthwhile when larger quantities of ORWOCOLOR materials are processed, or when self-processing is carried out because of a special photographic hobby; otherwise it is strongly recommended, – and this applies especially to ORWOCOLOR reversal film, – that processing be carried out by a reputable developing laboratory.

Working Diagram Scheme

In the following description of the ORWOCOLOR process in the form of a working diagram, the most important conversions are mentioned in addition to the processes. The ORWOCOLOR process is based on the same conversions which are applicable to the black-and-white process. The metallic silver, in this instance, however, has only an intermediate importance. The change-over to the coloured photograph takes place via the conversion products of the developer. Through the effect of the developer on the exposed components of the light-sensitive silver compound, the metallic silver occurs as a result of reduction. In the same ratio, developer oxidation products form from the developer. These react with the components of the emulsion, and combine to dyestuffs (colour couplings).

Due to the colour coupling, a bluish green (cyan) image occurs in the lower layer, next to the film base. The central layer contains the purple (magenta), the top layer the yellow dyestuff. The microscopic thin layer in our diagram shows the condition of processing only with layers which are of importance for the coloration. The auxiliary layers, which are in various ORWOCOLOR materials in different places, have not been taken into consideration.



The silver is not required for the final photograph. After corresponding conversion (bleaching), it is finally eliminated completely from the system, together with the unused silver compound, and may be reclaimed. Thus, this silver can serve again by technical processing for the production of photographic emulsions.

The diagrams on the following pages which are intended to illustrate the working process of black-and-white, and ORWOCOLOR, contain only the basically essential working stages.

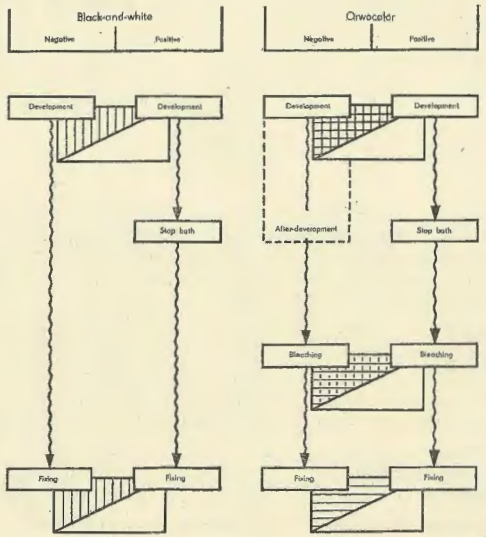
Each little square in the diagrams denotes a separate processing. The shading serves to illustrate the result of the respective chemical conversions:

vertical lines ..... metallic silver
vertical dotted lines ..... conversion product of silver
horizontal lines ..... colour construction

The wavy connections between the squares indicate the rinsing processes.

Negative-Positive Process

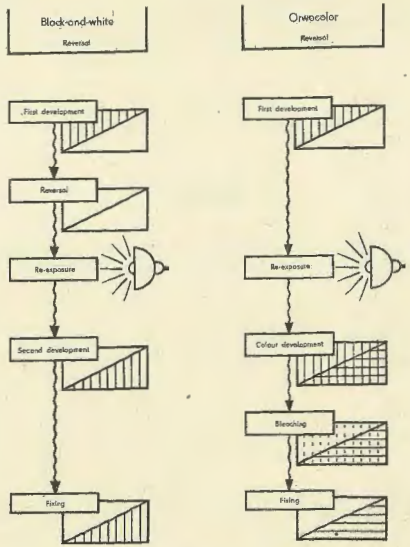
In the black-and-white process, the developed silver remains image substance. In the colour process silver and dyestuff occur simultaneously in the development. The metallic silver is converted, by bleaching, into a silver salt, which is dissolved out in the fixing bath. The construction of the photograph is taken care of solely by the dyestuff. This construction is somewhat different for ORWOCOLOR negatives and ORWOCOLOR positives. After ORWOCOLOR positive development, stopping take place; the development is, therefore, immediately interrupted similarly to the production of black-and-white prints or enlargements. In ORWOCOLOR negative processing, however, development is carried on in the subsequent rinsing by the developer absorbed by the emulsion, which continues to act until it is entirely washed out. This subsequent development, during rinsing, forms an indispensable part of the entire development.



A perfect negative of correct gradation of brightness and colour values, good utilization of the sensitivity and low density of fog is achieved only by correctly carried-out rinsing after developing.

Reversal Method

An ORWO reversal method is characterized by the fact that two developments are carried out one after the other on the same photographic material, these normally being separated by a second exposure. The first development results in metallic silver with black-and-white and also with ORWOCOLOR.



It is now necessary to dissolve out this silver. In the black-and-white process, this must take place prior to the second development, which results only in silver. With ORWOCOLOR reversal film, the second development has a colouring effect. Therefore, silver and colour are separated. In the black-and-white process, the dissolving out of the silver of the first development takes place in one process: reversal. With ORWOCOLOR, two processes are required with which the silver of the first and second development is removed simultaneously. Bleaching first converts the silver into silver salt, which, in a second stage – the fixing process – is dissolved out. In contrast to the silver image as a result of black-and-white reversal development, a pure colour image remains with ORWOCOLOR reversal development. The diagramatic comparison of the processing stages was intended to show how small are the differences in processing black-and-white and ORWOCOLOR materials. They do not fall outside the framework of known photographic methods. It has been the aim of our scientists and technicians to make the processing of ORWOCOLOR films and papers as simple as possible. The difficulties have been transferred to the production stage of ORWOCOLOR material.

More than 50 years ago, R. Fischer recognized the basic principle of colour development. Years of scientific research, years of technical progress were to pass before this basis was translated into a practical, usable method. This method has given good results for more than two decades. Many a colour picture has been made since then, many a coloured feature film has been projected on to the screen. The efficiency of the method has been perfected in the course of time, and colour films made in Wolfen continue to testify to the creative tradition under the Trade Mark

ORWOCOLOR

K 2 | ORWOCOLOR Processing Solutions according to Formulae

The publication of formulae enable the user to prepare for himself the requisite solutions for processing ORWOCOLOR film and ORWOCOLOR paper from individual chemicals.

To differentiate between ORWO formulae for black-and-white, these formulae are provided, before the corresponding number, with the marking "ORWOCOLOR". The film processing solutions are numbered below 100. Between 100 and 200 are the paper-processing solutions, subdivision into groups of ten still being made in both instances. The numbers above 200 are reserved for special baths.

In their effect, the solutions from the formulae correspond exactly to the processing solutions in the packs constituted as explained above (see pages 143 to 147).

The preparation of a solution for processing on formulae is carried out technically in the same manner as from ready-for-use packs. Also in this case, the chemicals must be weighed individually, with the applicability of the individual substances for ORWOCOLOR needing to be ensured and tested beforehand. This is all the more the case as ORWOCOLOR individual chemicals are not obtainable from the VEB Filmfabrik Wolfen.

For the self-preparation of ORWOCOLOR solutions, it is necessary to take into consideration a few conditions. Tap water may be used for preparation at a temperature of approximately 30 °C.

As a rule 750 ml of water are taken and the chemicals are dissolved one after the other in the stated sequence. Finally water is topped up to produce 1 litre.

For characterizing ORWOCOLOR solutions, which from the photographic view occupy a special position, the p_H value has been give in the last column of the formulae.

Formulas for ORWOCOLOR Film Processing Solutions

Designation	Formula			PH Value
ORWOCOLOR 09				
First-Developer for ORWOCOLOR Reversal- and Reversal Print Film	ORWO Anti-Lime Agent A 901	2	g.	7.2 to 7.4
	Sodium sulphite, anhydrous	50	g.	
	ORWO A 140	5	g.	
	Potassium bromide	2	g.	
ORWOCOLOR 09 R				
Regenerator for ORWOCOLOR 09	ORWO Anti-Lime Agent A 901	2	g.	7.2 to 7.4
	Sodium sulphite, anhydrous	80	g.	
	ORWO A 140	10	g.	
ORWOCOLOR 11				
Colour Developer for ORWOCOLOR Cine Film	Solution A:			
	Water	400	ml	10.9 to 11.1
	ORWO Anti-Lime Agent A 901	2	g.	
	Hydroxylamine sulphate	1.2	g.	
	Diethyl-p-phenylene-diamine sulphate	2.75	g.	
	Solution B:			
	Water	400	ml	
	ORWO Anti-Lime Agent A 901	2	g.	
	Potassium carbonate	75	g.	
	Sodium sulphite, anhydrous	2	g.	
	Potassium bromide	2	g.	
	After dissolving, solution A is poured slowly while stirring continuously into solution B, whereby the formation of air bubbles should be avoided as far as possible. Finally water is added to make up 1 litre.			
ORWOCOLOR 11 R/1				
Regenerator for ORWOCOLOR 11	Solution A:			
	Water	400	ml	10.9 to 11.1
	ORWO Anti-Lime Agent A 901	2	g.	
	Hydroxylamine sulphate	2	g.	
	Diethyl-p-phenylene-diamine sulphate	6	g.	
	Solution B:			
	Water	400	ml	10.9 to 11.1
	ORWO Anti-Lime Agent A 901	2	g.	
	Potassium carbonate	75	g.	
	Sodium sulphite, anhydrous	2	g.	
	After dissolving, solutions A is poured slowly while stirring continuously into solution B, whereby the formation of air bubbles should be avoided if possible. Finally water is added to make up 1 litre.			

Designation	Formula			PH Value
ORWOCOLOR 11 R/2				
Regenerator for ORWOCOLOR 11	Solution A:			
	Water	400	ml	10.9 to 11.1
	ORWO Anti-Lime Agent A 901	2	g.	
	Hydroxylamine sulphate	1.5	g.	
	Diethyl-p-phenylene-diamine sulphate	3.7	g.	
	Solution B:			
	Water	400	ml	
	ORWO Anti-Lime Agent A 901	2	g.	
	Potassium carbonate	75	g.	
	Sodium sulphite, anhydrous	2	g.	
	Potassium bromide	1.5	g.	
	After dissolving, solution A is poured slowly while stirring continuously into solution B, whereby the formation of air bubbles should be avoided as far as possible. Finally, water is added to make up 1 litre.			
ORWOCOLOR 13				
Colour Developer for ORWOCOLOR Film	Solution A:			
	Water	400	ml	10.7 to 11.0
	ORWO Anti-Lime Agent A 901	2	g.	
	Hydroxylamine sulphate	1.2	g.	
	Ethyl-oxyethyl-p-phenylene-diamine sulphate	6	g.	
	Solution B:			
	Water	400	ml	
	ORWO Anti-Lime Agent A 901	2	g.	
	Potassium carbonate	75	g.	
	Sodium sulphite, anhydrous	2	g.	
	Potassium bromide	2.5	g.	
	After dissolving, solution A is poured slowly while stirring continuously, into solution B, whereby the formation of air bubbles should be avoided as far as possible. Finally, water is added to make up 1 litre.			
ORWOCOLOR 13 R				
Regenerator for ORWOCOLOR 13	Solution A:			
	Water	400	ml	10.7 to 11.0
	ORWO Anti-Lime Agent A 901	2	g.	
	Hydroxylamine sulphate	2.5	g.	
	Ethyl-oxyethyl-p-phenylenediamine sulphate	8.7	g.	
	Solution B:			
	Water	400	ml	
	ORWO Anti-Lime Agent A 901	2	g.	
	Potassium carbonate	75	g.	
	Sodium sulphite, anhydrous	2	g.	
	After dissolving, solution A is poured slowly while stirring continuously into solution B, whereby the formation of air bubbles should be avoidedif as possible. Finally, water is added to make up 1 litre.			

Designation	Formula			PH Value
ORWOCOLOR 35 Hardening Stop Bath for ORWOCOLOR Positive Film and Paper	Sodium thiosulphate, crystalline	200	g.	4.0 to 4.5
	Sodium sulphite, anhydrous	7.5	g.	
	Sodium acetate	15	g.	
	Glacial acetic acid, conc.	25	ml	
	Potash alum	25	g.	
ORWOCOLOR 57 Bleaching Bath for ORWOCOLOR Film	Potassium cyanoferrate (III)	100	g.	6.2 to 6.4
	Potassium bromide	15	g.	
	Potassium dihydrogen-phosphate	5.8	g.	
	Di-sodium hydrogen phosphate	4.3	g.	
	4.3 g. di-sodium hydrogen phosphate can be substituted by 1.6 g. tetra-sodium di-phosphate anhydrous. In this case 2 g. of ORWO Anti-Lime Agent A 901 per litre should be added. (ORWOCOLOR 57/2).			
ORWOCOLOR 71 Fixing Bath for ORWOCOLOR Film	Sodium thiosulphate, crystalline	200	g.	7.5 to 7.8
ORWOCOLOR 73 Rapid Fixing Bath for ORWOCOLOR Film	Sodium thiosulphate, crystalline	120	g.	6.6 to 6.8
	Ammonium chloride	80	g.	

Formulas for ORWOCOLOR Paper Processing Solutions

Designation	Formula			PH Value
ORWOCOLOR 112 Colour Developer for ORWOCOLOR Paper	**Solution A:**			
	Water	400	ml	10.6 to 10.8
	ORWO water softener A 901	2	g.	
	Hydroxylamine sulphate	2	g.	
	Ethyl-oxyethyl-p-phenylene diamine sulphate	4.5	g.	
	Solution B:			
	Water	400	ml	
	ORWO water softener A 901	2	g.	
	Potassium carbonate	75	g.	
	Sodium sulphite, anhydrous	0.5	g.	
	Potassium bromide	0.5	g.	
	After dissolving, solution A is poured slowly, while stirring continuously into solution B, whereby the formation of air bubbles should if possible be avoided. Finally, water is added to make up 1 litre.			
ORWOCOLOR 112 R Regenerator for ORWOCOLOR 112	**Solution A:**			
	Water	400	ml	10.6 to 10.8
	ORWO water softener A 901	2	g.	
	Hydroxylamine sulphate	2	g.	
	Ethyl-oxyethyl-p-phenylene diamine sulphate	5	g.	
	Solution B:			
	Water	400	ml	
	ORWO water softener A 901	2	g.	
	Potassium carbonate	75	g.	
	Sodium sulphite, anhydrous	1	g.	
	Potassium bromide	0.25	g.	
	After dissolving, solution A is poured slowly while stirring continuously into solution B, whereby the formation of air bubbles should be avoided as far as possible. Finally, water is added to make up 1 litre.			

Designation	Formula			PH Value
ORWOCOLOR 152 Bleaching Bath for ORWOCOLOR Paper	Potassium cyanoferrate (III)	20	g.	6.2 to 6.6
	Potassium dihydrogen phosphate	12	g.	
	Di-sodium hydrogen phosphate	8	g.	
	8 g. of di-sodium hydrogen phosphate can be substituted by 3 g. tetra-sodium di-phosphate, anhydrous. In this instance 2 g. of ORWO Anti-Lime Agent A 901 should be added. (ORWOCOLOR 152/2).			
ORWOCOLOR 168 Bleaching-Fixing Bath for ORWOCOLOR Paper	Potassium carbonate	30	g.	7.0 to 7.2
	Ethylene diamine tetra-acetic acid di-sodium salt	55	g.	
	Ferric (III) chloride, crystalline	25	g.	
	Sodium thiosulphate, crystalline	120	g.	
	Potassium bromide	20	g.	
	25 g. of ferric (III) chloride, crystalline can be substituted by 37 g. of ferric (III) sulphate, anhydrous. (ORWOCOLOR 168/2.)			
ORWOCOLOR 176 Fixing Bath for ORWOCOLOR Paper	Benzene sulphinic acid sodium	2	g.	7.7 to 8.0
	Sodium thiosulphate, crystalline	200	g.	
ORWOCOLOR 184 Hardening Bath for ORWOCOLOR Paper	ORWO Anti-Lime Agent A 901	8	g.	10.1 to 10.3
	Sodium sulphate, anhydrous	150	g.	
	Sodium carbonate, anhydrous	20	g.	
	Formaldehyde (35%)	25	ml	

Formulae for ORWOCOLOR Special Baths

Designation	Formula			PH Value
ORWOCOLOR 201 Intermediate Bath for ORWOCOLOR Films and Paper	Magnesium sulphate (only required for soft water)	20	g.	5.2 to 5.8
ORWOCOLOR 205 Stabilising Bath for ORWOCOLOR Films	Sodium acetate, anhydrous	60	g.	5.4 to 5.8
	Aluminium sulphate	20	g.	
	20 g. aluminium sulphate can be replaced by 30 g. of potash alum (ORWOCOLOR 205/2)			
ORWOCOLOR 209 Black-and-White Developer for Re-development of the Sound Track of ORWOCOLOR Cine-positive Film Type PC 5, PC 7 and PC 9	Solution A:			
	Water	350	ml	—
	Sodium sulphite, anhydrous	100	g.	
	Potassium hydroxide	60	g.	
	ORWO H 142	30	g.	
	Solution B:			
	Water	400	ml	
	Cellulose glycolicacid-sodium	60	g.	
	Solution A is stirred into solution B, which has been made to swell, and diluted with water to 980 ml. Subsequently 20 ml ethylene diamine (approx. 60%) are added to make up 1000 ml. The quantity of cellulose glycolicacid sodium should be regarded for guidance only, it depends on the required viscosity of the solution.			

K 3 | ORWOCOLOR Processing Solutions from Ready-to-use Packs

For processing ORWOCOLOR film and ORWOCOLOR paper, the required chemicals are supplied in ready-to-use packs, which serve for preparing the processing solutions. The composition of the various ORWOCOLOR materials required for processing solutions may be obtained from the following table:

ORWOCOLOR	Reversal Film Reversal Print Film	Negative Film	Positive Film
First Developer C 09	×		
Colour Developer C 13	×	×	×
Stop-hardening Fixing Bath C 35			×
Bleaching Bath C 57	×	×	×
Fixing Bath C 71		×	×
Hardening Fixing Bath C 75	×		

ORWOCOLOR		Paper
Colour Developer	C 112	×
Stop-hardening Fixing Bath	C 35	×
Bleaching Bath	C 152	×
Fixing Bath	C 176	×
Hardening Bath	C 184	×
Light-protective Bath	C 203	×

ORWOCOLOR Film Processing Solutions

Commercial Sizes: Individual packs for 0.4 litres
1 litres
5 litres
15 litres
35 litres

The packs contain the substances in solid consistencies. (Sometimes in several parts.)

Development Sets

Some of the above packs are combined into convenient development sets. The following are available as complete units:

ORWOCOLOR Reversal Film
Development set for 0.4 litres
1 litre

ORWOCOLOR Negative Film
Development set for 0.4 litres*
1 litre

For working on a larger scale it is required to regenerate the developer solutions in order to maintain their efficiency as constant as possible for a long period. For producing the corresponding solutions, the following **Regenerators** are supplied:
Regenerator **C 09 R** for First Developer C 09
Regenerator **C 13 R** for Colour Developer C 13.
Packs for 5 and 15 litres of regenerator solution.

Instructions for Dissolving

The substances are dissolved, according to the following specification, with water at 20 to 30 °C.
The use of distilled water is not required when using ready-to-use packs. It is recommended to prepare the solutions about one day prior to use. The developer solutions should be kept in brown, closed bottles, or covered tanks.

* These developer sets contain the chemicals for preparing 2 × 400 ml colour developer, which produces an economical method of working.

First Developer C 09

Regenerator C 09 for First Developer C 09

After completely dissolving the contents of part B in ¾ of the requisite quantity of water, part A is added, dissolved and topped up to the specified final volume.

Colour Developer C 13

Regenerator C 13 R for Colour Developer C 13

These packs contain the substances in solid consistencies as parts A1, A2 and B. parts A and B are dissolved separately.
Part A1 should always be dissolved before part A2 in the specified quantity of water.

pack for	0.4	1	5	15	35 litres of developer
dissolve part A in	0.15	0.4	2	6	15 litres of watar
dissolve part B in	0.15	0.4	2	6	15 litres of water

Subsequently A is poured slowly into B whilst stirring continuously, whereby the formation of air bubbles should be avoided as far as possible. Finally, water is added to top up to the specified final volume.

Attention!

The regenerator solutions must under no circumstances be used as developers on their own.

Stop-Hardening Fixing Bath C 35

Parts 1, 2 and 3 should be dissolved in the stated sequence in ¾ of the requisite quantity of water. Subsequently water is added to make up the specified final volume.

Bleaching Bath C 57

Fixing Bath C 71

The substances should be dissolved in ³/₄ of the requisite quantity of water. Subsequently water is added to make up the specified final volume.

Hardening Fixing Bath C 75

Parts 1 and 2 are dissolved one after the other in ¾ of the requisite quantity of water, at 20 to 25 °C. Subsequently water is added to make up the specified final volume.

ORWOCOLOR Paper Processing Solutions

Commercial Sizes: Individual Packs for 1 litre
5 litres
15 litres
25 litres
developer set for 1 litre

The packs contain the substances in solid consistencies (sometimes in several parts). The developer set contains the chemicals for preparing 2 × 1 litre of colour developer, which results in an economical method of working. If working on a larger scale, it is necessary to regenerate developer solution, in order to keep its efficiency constant over a longer period. To prepare the corresponding solution, the following **regenerator** is supplied:

Regenerator **C 112 R** for colour developer C 112.
Packs for 5 litres regenerator solution.

Instructions for Dissolving

The solid substances are dissolved, according to the following instructions, with water at 20 to 30 °C.
When using ready-for-use packs the use of distilled water is not required. It is recommended to prepare the solution one day prior to use. The developer solution should be stored in brown, closed bottles or covered tanks.

Colour Developer C 112

Regenerator C 112 for Colour Developer C 112

Parts A and B are dissolved separately. Part A1 should always be dissolved before part A2 in the specified quantity of water.

Packs for	1	5	15	25 litres of developer
dissolve part A in	0.4	2	6	10 litres of water
dissolve part B in	0.4	2	6	10 litres of water

Subsequently Part A is slowly poured into part B whilst stirring continuously, whereby the formation of air bubbles should be avoided as far as possible. At last water is added to make up the final volume.

Attention!

The regenerator solution must, under no circumstances, be used as a developer on its own.

Stop-Hardening Fixing Bath C 35

Parts 1, 2 and 3 should be dissolved in the stated sequence in ¾ of the requisite quantity of water. Subsequently water is added to make up the specified final volume.

Bleaching Bath C 152

Fixing Bath C 176

Hardening Bath C 184

The substances should be dissolved in ¾ of the requisite quantity of water. Subsequently, water is added to make up the specified final volume.

Light-Protective Agent C 203

The substance is dissolved in the entire quantity of water specified at 20 to 30 °C.

Regeneration

The 15 litre pack is supplied in a bag, which is hung into the tank for regeneration. The efficiency of the solution is thus maintained for a prolonged period.

ORWOCOLOR materials are processed in the above-described processing solution. It is recommended to prepare the solution at least 12 hours prior to use, and to keep them in brown, closed bottles, or covered tanks.

Before enumerating the various processing stages, a few points of a general nature should first be discussed, as they show the coincidence of the various processes, or deserve special mention.

ORWOCOLOR
- Reversal Process
- Negative/Positive Process
- Paper Process

The **handling of processing solutions** in the ORWOCOLOR process requires scrupulous cleanliness in preparation, as well as in use. The dissolving of solid substances must be carried out without dust generation. Reciprocal contamination of the baths must also be avoided. First- and colour developers must be free from impurities from the other solutions, especially from the fixing bath.

The type of the container material, the consistency of the container and cleanliness, makes exacting demands. Before use, one has to make certain of the stability of containers, frames and clips. Especially corrosive is the bleaching bath, which even affects some types of stainless steel. Recently, plastics have been widely used for containers. It is, furthermore, an advantage to use separate containers for the preparation, storage and processing of the solutions. From a physiological respect, the same points apply as in black-and-white photography. The developer substances have a skin-irritation effect only on sensitive persons. Caution is advised with the bleaching bath. This solution must not get into the bloodstream through open wounds, or into the stomach through the mouth.

The effect of processing solutions on the ORWOCOLOR emulsion depends, in addition to its condition, also on the shape and size of the containers used, the type and intensity of agitation, the temperature of the baths, and processing time.

Working Containers

When selecting working containers, technical and economic points of view should be taken into consideration: For the size and thus, for the raw material, the number and throughput of the ORWOCOLOR material to be processed, play a decisive part. A number of different sizes and shapes exist, from the developing box of small content for the occasional work of the amateur, the professional photographer, the reporters, institutes and research laboratories and work laboratories, and the large tank equipments with considerable capacity, for the colour laboratory, for which corresponding ready-for-use packs are available.

The **developing box** of the usual type is suitable only for ORWOCOLOR miniature, roll- and substandard films. The **tank** can be applied more generally. In addition, it is possible to process ORWOCOLOR sheet films and ORWOCOLOR papers in the tank; processing in the **dish** can be carried out only with these latter.

With firmly installed tanks equipment, the use of the individual tanks is ensured exclusively for a respective solution. For working in developing boxes, as many boxes as baths are required, and each box should always stand in the same position in the processing stage. Under no circumstances must colour and black-and-white solutions be used alternately.

Where greater efficiency is required, several containers should always be used and for a longer processing time. With double the number of containers for the first development of reversal films, a 16 minute cycle, and thus double the output, is obtained. With reversal miniature films, there is a possibility of rolling two films, back to back, into the box insert. This process can, however, only be applied to colour films, as they have no backing.

The basic requirement for every container is that the various solutions should have the possibility of acting uniformly on the emulsion. Furthermore, the water must be able easily to reach the front and back of the material.

Soaking, Preliminary Swelling

The uniformity of the development of ORWOCOLOR films can be rendered safer by safer by prior soaking. Due to the preliminary swelling of the emulsion in heated water (2 minuts at 18 °C), defects in wetting (air bubbles) and irregularities in the image structure (formation of shadows) can be avoided.

Agitation

Agitation of the mounts during processing in the baths is carried out with certain precautions, which are separately noted in their respective places in the description of the working processes. In addition mention should be made of the following on this point: the frames with the material to be developed are, in the beginning, repeatedly lifted completely out of the **tank** so as to remove any adhering air bubbles. This method is also recommended for the **developing box**. In order to bring the film into contact

with the processing solutions, and to eliminate air bubbles, despite its close winding, the insert should repeatedly be immersed and withdrawn again in the dark. After replacing the cover, work is continued in bright light. Avoidance of any uniformity is important when agitating the material to be developed. In the **dish**, swinging, in either direction, must not be too uniform. In the **box** intermittent turning is better than a uniform rotary movement. In the **tank** the frame should not only be moved up and down, but by means of loose guides, there should also be the possibility of lateral movement.

Second Exposure

The second exposure required for reversal films, necessitates the use of certain precautionary measures. With modern developing machines, or tank equipment, exposure is carried out in the tank under water. Developing frames in this instance have paths of transparent plastic eliminating imperfect exposure due to shadows. In developing boxes of a modern type the box insert is also made of transparent plastic. This considerably facilitates the second exposure, because the film remains in the insert. Otherwise it is necessary to expose the film outside the box, under special precautions (see page 154, footnote ***). For this purpose the film must be removed from the box insert and be subsequently replaced, the wet emulsion needing to be treated with particular care to avoid damage. This can be facilitated by keeping film and box insert under water in the course of this process. There is also the possibility of drying the film prior to colour development.

Rinsing

The required intermediate and final rinsing processes must be particularly extensive in ORWOCOLOR processing. In **tank** and **dish** processing, the water should be supplied easily and directly to the emulsion. The water should be supplied through a dividing system, which eliminates directional effects and flow phenomena, equally with areas which would lie in the shadow of the water.

In the **developing box**, the conditions of flow are not so suitable, because with the helical winding, with its narrow spaces, the water cannot reach the emulsion as easily. It is recommended to carry out rinsing in a separate larger container.

Of the various **rinsing processes**, the first rinsing is of particular importance in ORWOCOLOR negative development. It should be regarded as a subsequent development, which is important for the structure of the photograph. The specified time must be maintained in order to avoid the occurrence of a bleaching fog. If components of the colour developer substance remain in the emulsion, undesirable, coloured fogs remain. The rinsing temperature may be reduced to 12 °C. Temperatures above 18 °C should, however, be avoided.

Mechanical, motor driven devices eliminate influences depending on the temperament of the person. A newer type of agitation of the tank liquid is by the depression of nitrogen through the developers, of air through the other baths and the rinsing processes. These irregular gas- and air surges – under no circumstances must they be a fine spray – lift the frames briefly, mix the tank contents thoroughly, and permit an extensive interchange of solution in the emulsion. A perfect agitation effect is obtained more safely and uniformly, than with much more expensive pumping equipment.
In order to eliminate flow phenomena, agitation of the first and colour development should be started immediately on placing the material in the container for developing. For the same reason, agitation should be carried out after colour development, and also during subsequent rinsing.

Working Temperature, Processing Times

The working temperature, insofar as not otherwise specified, should not exceed 18 °C under any circumstances. It should definitely be maintained for development, as should be the specified time. Both together result in an optimum effect and uniformity of results. The possibility, known from the black-and-white process, of compensating lower developing temperatures by extended developing times does exist, but for reasons of safety, is not recommended. With higher temperatures and reduced developing time, there exists the danger of an excessive swelling of the gelatine, which may even result in a peeling-off of the emulsion. Care should also be taken not to touch ORWOCOLOR film and ORWOCOLOR paper unnecessarily on the emulsion side in the course of processing. The formation of spots and mechanical damage results, in such places, in defects of the colour balance, which can only be eliminated with difficulty by retouching.
Conditions are no longer quite so exacting for a processing solution subsequent to development. The **temperatures** may range from 16 and 18 °C; it is always worthwhile to endeavour remaining, as far as possible, below the upper limit, and not to exceed 17 °C with the bleaching bath. The **times** in the processing diagram apply as a minimum to the subsequent bath. They may well be exceeded slightly without endangering the result.

Hardness of the Water

Soft Water, occurring in some areas, may result in the formation of small blisters, and possibly even in the emulsion peeling off. To avoid this, it is recommended, subsequent to development, to insert immediately an intermediate bath (ORWOCOLOR 201). The films are left 2 to 3 minutes in this magnesium sulphate bath. Following this, work is continued as specified. The intermediate bath has the same life as the colour developer. With the magnesium sulphate bath, the developing time should be reduced by approximately 10%.

Drying

Prior to drying, it is recommended to remove adherent drops carefully by wiping with a soft sponge or leather. The drying itself should be carried out, free from dust, at a temperature up to a maximum of 30 °C, and as quickly as possible. Any unnecessary extension affects the colour characteristics of ORWOCOLOR paper.

Illumination of the Workroom

Care must be taken with illumination of the darkroom when working with ORWOCOLOR material. With ORWOCOLOR negative film and reversal film, it is best to work entirely in the dark. ORWOCOLOR positive film and ORWOCOLOR paper may be processed in greenish-yellow light.
Permissible screens and technical data are listed in the table of ORWO darkroom safe-light screens: pp. 184, 185.

Life of the Solutions

The life of the solutions depends on the type of storage. If cleanliness is ensured, the first developer will keep for a week in brown, closed bottles (also when unused); the other solutions keep for approximately 4 weeks.

a) Working Process for ORWOCOLOR Reversal Film (I) and ORWOCOLOR Reversal Print Film (II)

Processing Times in Minutes at 18 °C (box or Tank)

Working Process	ORWOCOLOR Baths after Formulae	from Packs	I	II
1. First Developing*	ORWOCOLOR 09	First Developer C 09	32	15 to 20
(Intermediate Bath)**	ORWOCOLOR 201		2 to 3	
2. Rinsing			25	
3. Second Exposure***			5	
4. Colour Developing****	ORWOCOLOR 13	First Developer C 13	10	10 to 14
(Intermediate Bath)**	ORWOCOLOR 201		2 to 3	
5. Rinsing			25	
6. Bleaching	ORWOCOLOR 57	Bleaching Bath C 57	5	
7. Rinsing			10	
8. Hardening-fixing	ORWOCOLOR 71 †	Hardening-fixing Bath C 75	5	
9. Final Rinsing			25	

* Agitation only at the commencement: turn moderately in the box for 5 minutes, move upwards downwards in the tank for 10 minutes.

** Required only in the case of soft water (see p. 152).

*** The second exposure is an important processing stage for reversal film. The necessary exposure of the residual silver salt must be carried out from both sides. It requires a strong light source, the heat radiation of which may, however, constitute a hazard for the gelatine. To avoid melting, a lamp distance of 75 cm. should be maintained. Adequate light transmission is achieved with 500 watts. Water drops, especially at the back, have a disturbing effect on exposure and result in red rings. These must definitely be removed previously by wiping with a soft sponge or leather. The red rings can also be avoided by the use of ORWO wetting agent F 905 (see p. 124). After the second exposure, work is continued in the bright light.

**** Continuous moderate agitation.

† This bath has no hardening action; it is therefore recommended to extend the process as follows: 5 minutes rinsing, 5 minutes ORWOCOLOR 205, then final rinsing.

Utilization of Solution per Litre

	Miniature Film for 36 Exposures or Roll Film 120
First Developer without Regeneration	3 to 4 pieces
First Developer with Regeneration*	8 pieces
Colour Developer without Regeneration	7 to 8 pieces
Colour Developer with Regeneration*	12 pieces
Bleaching Bath	12 pieces**
Hardening-Fixing Bath	15 pieces

* Regeneration is carried out in such a manner that, after developing a film strip or the corresponding area of a sheet film, 50 ml of the corresponding regenerator is added to the 40 ml of first developer.

** An increase in utilization to almost double can be achieved by the further addition of 20 g. of potassium bromide per litre of bleaching bath.

b) Working Process for ORWOCOLOR Negative Film

Processing Time in Minutes at 18 °C

Working Process	ORWOCOLOR Baths after Formulae	from Packs	Dish	Box	Tank
1. Colour Developing*	ORWOCOLOR 13	Colour Developer C 13	5	4	5
(Intermediate Bath)**	ORWOCOLOR 201		2 to 3	2 to 3	2 to 3
2. Rinsing			15	25	15
3. Bleaching***	ORWOCOLOR 57	Bleaching Bath C 57	5	5	5
4. Rinsing			5	5	5
5. Fixing	ORWOCOLOR 71	Fixing Bath C 71	8	8	8
6. Final Rinsing			15	25	15

* Exposures from coloured originals (reproductions) must be developed more contrasty. The same applies also to motifs with flat illumination or low contrast.

Dish 7 minutes
Box 5 minutes
Tank 7 minutes

The films should be continuously and moderately agitated during colour development.

** Required only for soft water (see p. 152).

*** Processing up to the bleaching must be carried out in suitable darkroom illumination. If the ORWOCOLOR film is in the bleaching bath for approximately 1 minute, the processing may be continued in bright light.

Utilization of Solutions per Litre

	Miniature Film for 36 Exposures or Roll Film 120	Sheet Film 9 cm × 12 cm
Colour Developer without Regeneration	7 pieces	40 sheets
Colour Developer with Regeneration	11 pieces	55 sheets
Bleaching Bath	12 pieces	70 sheets
Fixing Bath	14 pieces	80 sheets

Regeneration is carried out in such a manner that, after developing a film strip, or the corresponding area of the sheet film, 50 ml of regenerator is added to the colour developer.

c) Working Process for ORWOCOLOR Positive Film (not for cine-film purposes).

Processing Times in Minutes at 18 °C

Working Process	ORWOCOLOR Baths after Formulae	ORWOCOLOR Baths from Packs	Dish	Box	Tank
1. Colour Developing*	ORWOCOLOR 13	Colour Developer C 13	11	8	11
(Intermediate Bath)**	ORWOCOLOR 201		2 to 3	2 to 3	2 to 3
2. Rinsing			1½	1½	1½
3. Stop-hardening Fixing	ORWOCOLOR 35	Stop-hardening Fixing bath C 35	6	6	6
4. Rinsing			15	15	15
5. Bleaching***	ORWOCOLOR 57	Bleaching Bath C 57	5	5	5
6. Rinsing			5	5	5
7. Fixing	ORWOCOLOR 71	Fixing Bath C 71	5	5	5
8. Final Rinsing			15	25	15

* Continuous moderate movement.

** Only required for soft water (see p. 152).

*** The processing up to stop-hardening fixing must be carried out in suitable darkroom illumination. If the ORWOCOLOR film is in the stop-hardening fixing bath for approximately 1 minute, processing may be continued in bright light.

Utilization of Solutions per Litre

	Transparency Film 35 mm	Sheet Film 9 cm × 12 cm
Colour Developer without Regeneration	10 m	30 sheets
Colour Developer with Regeneration	18 m	55 sheets
Stop-hardening Fixing Bath	20 m	60 sheets
Bleaching Bath	20 m	60 sheets
Fixing Bath	20 m	60 sheets

The regeneration is carried out in such a manner that, after developing 1.5 m of 35 mm film, or the corresponding area of sheet film, 50 ml of regenerator is added to the colour developer.

d) Working Process for ORWOCOLOR Paper

Processing Times in Minutes at 18 °C

Working Process	ORWOCOLOR Baths after Formulae	from Packs	Dish or Tank
1. Colour Developing*	ORWOCOLOR 112	Colour Developer C 112	5
2. Rinsing			⅓*
3. Stop-hardening Fixing**	ORWOCOLOR 35	Stop-hardening Fixing Bath C 35	5
4. Rinsing			10
5. Bleaching	ORWOCOLOR 152	Bleaching Bath C 152	5
6. Rinsing			10
7. Fixing	ORWOCOLOR 176	Fixing Bath C 176	5
8. Rinsing			20
9. Hardening	ORWOCOLOR 184	Hardening Bath C 184	5
10. Rinsing			5
11. Stabilizing***		Light-protective Bath C 203	5

Instead of baths 5 to 7, it is also possible to use the bleaching-fixing bath "ORWOCOLOR 168" (for formula see p. 141). Processing time 10 min. The fourth rinsing, can, in this instance, be reduced to 5 minutes.

* According to the rinsing conditions, the intermediate rinsing can be extended to 5 minutes. Shor times are, however, to be aimed at.

** The processing up to the stop-hardening fixing must be carried in suitable darkroom illumination. If ORWOCOLOR paper is in the stop-hardening fixing bath for approximately 1 minute, processing can be continued in bright light.

*** Improves the life of the dyestuffs in daylight.

Utilization of Solutions per Litre

	Paper 9 cm × 12 cm
Colour Developer without Regeneration	50 sheets
Stop-hardening Fixing Bath	100 sheets
Bleaching Bath	100 sheets
Bleaching-Fixing Bath	50 sheets
Fixing Bath	200 sheets
Hardening Bath	200 sheets
Light-protective Bath, when processing dry photographs without regeneration	400 sheets
Light-protective Bath, when processing wet photographs without regeneration	150 sheets

Regeneration of the colour developer is effected in such a manner that, after developing 10 sheets of size 9 × 12 cm. 100 ml of **regenerator** is added. Any quantity missing from the initial volume should be compensated with **colour developer**.

Regeneration of the colour developer may be continued until a decrease in efficiency can be noticed on the tests carried out simultaneously.

e) Working Process for ORWOCOLOR Cine-Negative Film

Processing Times in Minutes at 20 °C

Working Process	ORWOCOLOR Baths	Machine
1. Colour Developing	ORWOCOLOR 11	5
2. Spray Rinsing		15
3. Bleaching	ORWOCOLOR 57	5
4. Spray Rinsing		5
5. Fixing	ORWOCOLOR 73	8
6. Final Rinsing		15

f) Working Process for ORWOCOLOR Cine-Dup-Film

Processing Times in Minutes at 18 °C

Working Process	ORWOCOLOR Baths	Machine
1. First Developing	ORWO 20	15
2. Spray Rinsing		15
3. Second Exposure*		
4. Colour Developing	ORWOCOLOR 11	11
5. Spray Rinsing		15
6. Bleaching	ORWOCOLOR 57	5
7. Spray Rinsing		5
8. Fixing	ORWOCOLOR 73	5
9. Final Rinsing		15

* Exposure of both sides of the film with a strong light source. (500 watt lamp). Distance: 25 cm; exposure time approximately ½ minute.

g) Working Process for ORWOCOLOR Cine-Positive Film

Processing Times in Minutes at 20 °C

Working Process	ORWOCOLOR Baths	Machine
1. Colour Developing	ORWOCOLOR 11	8 to 10
2. Spray Rinsing		1½
3. Stop-hardening Fixing	ORWOCOLOR 35	6 to 8
4. Spray Rinsing		10
5. Bleaching	ORWOCOLOR 57	5
6. Spray Rinsing		5
7. Draining of Liquid from Film		
8. Re-developing sound-track	ORWOCOLOR 209	1½
9. Spray Rinsing		3
10. Fixing	ORWOCOLOR 73	5
11. Final Rinsing		15

ORWO

Tables

Table of Chemicals

In the following list, the substances used in photographic processing are listed and described. The main designations of the chemicals in column 1 were largely adapted to the nomenclature, compiled in 1959, by the International Union for Pure and Applied Chemistry. Thus, "natriumhydroxid" (sodium hydroxide) no longer appears with the termination "yd", but instead with "id".

Furthermore, acid salts are denoted by "hydrogen" and not "bi".

For instance, "Natriumbisulfit" (sodium bisulphite) becomes „Natrium hydrogensulfit" (sodium hydrogen sulphite). The still-used, but nolonger-desirable designations are found adjacent to the commercially-used designations in the second column.

Some traditional terms are retained from a practical consideration: e. g. "Kalialaun" (potash alum), instead of more correctly "Kaliumaluminiumsulfat" (potassium aluminium sulphate).

The designation possible, in accordance with the new nomenclature for Na_2SO_3, "Natriumtrioxosulfat" (sodium trioxosulphate) instead of sodium sulphite, was not introduced into the book of formulae for similar reasons.

Table of Chemicals

Designation/Formula		Other Designations	Appearance/Properties	Application
Acetone	$(CH_3)_2CO$	Dimethyl ketone	Water clear liquid, easily combustible	Component of adhesive
Alcohol	C_2H_5OH	Ethyl alcohol, ethanol, wine spirit; spiritus vini; denatured: methylated spirit	Colourless liquid/combustible, of pleasant odour and burning taste	Solvent, rapid drying agent, additive to hardening bath
Alum, see potassium-iron or chrome alum		—	—	—
Aluminium sulphate	$Al_2(SO_4)_3$	Sulphuric acid aluminium	White powder or extremely hard pieces	For stabilizing bath
Ammonia solution	NH_4OH	Caustic ammonia, ammonium hydroxide ammonia solution, liquor ammonii caustici	Colourless liquid of penetrating odour. Caustic!	Blackening bath in sublimate intensification
Ammonium chloride	NH_4Cl	Sal ammoniac, ammoniac salt, ammonium chloratum	White crystalline powder	Component of rapid fixing bath
Ammonium peroxodosdiulphate	$(NH_4)_2S_2O_4$	Ammonium persulphate, persulphuric ammonium, ammonium persulphuricum	Colourless crystal/crackles on dissolving	
Benzoquinone	$C_6H_4O_2$	p-Benzoquinone, quinone	Easily decomposed; to be kept well-closed	Reducer
Bisulphite lye, see sodium hydrogen sulphite		—	Yellow crystals/instense pungent odour	Reducer
Borax, see sodium tetraborate		—	—	—
Bromide of potassium, see potassium bromide		—	—	—
Camphor	$C_{10}H_{16}O$	—	—	—
Caustic potash, see potassium hydroxide		—	White crumbly compound, pleasant odour	Component of adhesive
Caustic soda, see sodium hydroxide		—	—	—
Cellulose glycolic acid sodium		Zellin S	—	—
Citric acid	$(CH_2COOH)_2COHCOOH$	Acidum citricum	White, crumbly compound/alkaline reaction	For re-developing soundtracks
Copper sulphate	$CuSO_4$	Copper(II) sulphate, sulphate of copper, blue vitriol, cuprous sulphate, cuprum sulphuricum	Colourless crystals	For developers and intensifiers
			Dark blue crystals	For bleaching baths
Chrome alum	$KCr(SO_4)_2$	Potassium chromosulphate, alumen chromicum	Dark-violet crystals	For hardening
Diethyl-p-phenylene-diamine sulphate	$NH_2C_6H_4N(C_2H_5)_2 . H_2SO_4$	T 22	Fine crystals	Colour developer substance
Disodium hydrogen phosphate	Na_2HPO_4	Dibasic sodium phosphate, di-sodium phosphate, sodium phosphate secondary	Damp, easily-decomposing crystals	Component of various ORWOCOLOR processing solutions
Distilled water	H_2O	Aqua destillata	—	For preparing solutions in special cases
Ether	$(C_2H_5)_2O$	Diethyl ether	Water-clear liquid; characteristic odour, ether-air-vapour mixture, explosive	Solvent
Ethylenediamine tetra acetic acid disodium salt	$(HOOCCH_2)_2N(C_2H_4)N(CH_2COONa)_2$	Chelaplex III, komplexon III, trilon BF, M 23	Fine white crystals	Complex former in the bleaching fixing bath, anti-lime
Ethyl-oxy-ethyl-p-phenylenediamine sulphate	$NH_2C_6H_4NC_2H_4OC_2H_4H_2SO_4$	T 32	Fine crystals	Colour developer substance
Formaldehyde	HCOH	Formaline, formaldehyde, solutus	Water-clear liquid of characteristic odour Caustic! Toxic!	Hardening agent
Glacial acetic acid	CH_3COOH	Concentrated acetic acid, acidum aceticum glaciale, diluted acetic acid	Water clear liquid/strongly pungent odour. Caustic!	For stop and fixing baths; intensifier

Designation/Formula		Other Designations
Glauber salt, see sodium sulphate		—
Gold chloride	$AuCl_3$	Gold(III) chloride, chlorgold, auric chloride, aurum chloratum
Hydroquinone	$C_6H_4(OH)_2$	Paradioxybenzene, H 142
Hydroxylamine sulphate	$NH_2OH \cdot \frac{1}{2}H_2SO_4$	Sulphuric acid hydroxylamine, S 55
Hydroxydiaminobenzene	$C_6H_3OH(NH_2)_2 \cdot 2HCl$	1-hydroxy-2.4-diaminobenzene hydrochloride diaminophenol hydrochloride, A 140,
Hypo, see sodium thiosulphate		—
Iron alum	$(NH_4)Fe(SO_4)_2$	Ammonium iron (III) sulphate ferruginous alum, iron ammonia, ferri-ammonium sulfuricum
Iron (III) chloride	$FeCl_3$	Ferric chloride; ferrum sesquichloratum
Iodine potassium, see potassium iodide		—
Magnesium sulphate	$MgSO_4$	Bitter salt, magnesium sulphuricum
Mercury chloride	$HgCl_2$	Mercury (I chloride, mercuric chloride, sublimate, hydrargyrum bichloratum
Methanol	CH_3OH	Methyl alcohol
Methyl acetate	CH_3COOCH_3	—
Methylene chloride	CH_2Cl_2	Dichloromethane
Methyl glycol acetate	$CH_3CO_2(CH_2)_2OCH_3$	GMC
Monomethyl-p-aminophenol sulphate	$C_6H_4(OH)NH(CH_3) \cdot \frac{1}{2}H_2SO_4$	M 143
Oxalic acid	$(COOH)_2$	Clover acid, acidum oxalicum
Parahydroxyphenylglycin	$HO \cdot C_6H_4 \cdot NHCH_2 \cdot COOH$	Parahydroxyphenylaminoacetic acid, G 141
Paraminophenol, hydrochloric salt	$C_6H_4OHNH_2 \cdot HCl$	Chlorohydrate o' paraminophenol
Paraphenylenediamine, free base	$C_6H_4(NH_2)_2$	1.4-phenylenediamine
Phthalic acid dimethylester	$C_6H_4(CO_2CH_3)_2$	Palatinol M
Potash, see potassium carbonate		—
Potash alum		Potassium alum, alum, potassium aluminium sulphate, alumen kalicum
Potassium dichromate	$K_2Cr_2O_7$	Potassium bichromate, double chromic acid potassium, red chromic acid potassium, kalium bichromicum
Potassium bromide	KBr	Bromide of potassium, kalium bromatum
Potassium carbonate	K_2CO_3	Potash, carbonate of potassium, kalium carbonicum
Potassium cyanoferrate (III)	$K_3(Fe(CN)_6)$	Potassium ferricyanide, potassium hexacyanoferrate (III), kalium ferricyanatum
Potassium dihydrogen phosphate	KH_2PO_4	Monobasic potassium phosphate, potassium phosphate, primary

Appearance/Properties	Application
—	—
Brown pieces, deliquescent Poison! Toxic!	For toning baths
Colourless crystals	Developer substance
Almost white crystals	Component of colour developer
White to slightly grey crystal needles; works without alkali	Developer substance
—	—
Violet crystals	For reducers and toning baths
Deliquescing crystals	In bleaching fixing bath
—	—
Colourless crystals	For intermediate baths
White crystals/Toxic! Carefully marked and separately stored	To intensifiers
Colourless liquid, toxic, combustible	Solvent
Neutral colourless liquid, slight, ester-like odour	Component of adhesive
Water-clear liquid	Component of adhesive
Neutral colourless liquid	Component of adhesive
Colourless needles or prisms	Developer substance
Colourless crystals/Toxic! mark properly and store separately	For reducers
White crystals	Developer substance
Colourless crystals	Developer substance
White powder or white scales	Developer substance
Clear, crystal-clear liquid	Component of adhesive
—	—
Colourless, transparent crystals	For preparing hardening fixing baths; addition to fixing, hardening and toning baths
Orange-red crystals Toxic!	For reducers, reversal baths and cleansing solutions
White crystal cubes	Addition to developers, bleaching baths and toning solutions
White powder/water attracting. To be stored in bottles well-closed with rubber stoppers	Developer alkali
Dark red crystals/light-sensitive Toxic!	For bleaching and toning baths, intensifiers and reducers
Fine, long crystals, square needles	Component of various ORWOCOLOR solutions

Designation/Formula		Other Designation	Appearance/Properties	Application
Potassium disulphite	$K_2S_2O_5$	Potassium pyrosulphite, kalium metabisulfurosum, potassium metabisulphite	Hard, colourless crystals/with weak odour of sulphurous acid	Additive for developers, for stop baths, for acidulating fixing baths
Potassium ferricyanide, see potassium cyanoferrate (III)		—	—	—
Potassium hydroxide	KOH	Potassium hydroxide, caustic potash, caustic potassium, potassium hydrate, kalium hydricum, kalium causticum; in solution: potash lye, liquor kalii caustici	White substance in pieces, bars, plates or scales/ water attracting, to be stored well-closed with rubber stoppers. Very caustic	Developer alkali
Potassium iodide	KI	Iodide of potassium, kalium iodatum	White crystals in cubes	Additive to intensifiers
Potassium permanganate	$KMnO_4$	Hyper-permanganate of potassium, kalium permanganicum	black-violet, glossy needles or crystals	For reducers and cleansing solutions
Potassium thiocyanate	KSCN	Potassium rhodanide, rhodano-potassium, sulphocyano potassium, potassium sulphocyanate, kalium rhodanatum	Colourless crystals/deliquescent, stored protected against light	Additive to reversal developer
Pyrocatechin	$C_6H_4(OH)_2$	Orthocatechin benzene	White crystals	Developer substance
Pyrogallol	$C_6H_3(OH)_3$	Pyrogallic acid, 1,2,3-trioxybenzene	Sublimated: colourless needles crystalline: coarse crystals	Developer substance
Raschit	$C_6H_3CH_3OHCl$	p-Chlor-m-cresol	Yellowish crystals/phenolic odour	Disinfectant prior to black-and-white reversal development
Soda, see sodium carbonate		—	—	—
Selene	Se	Selenium	Amorphus selenium: red powder. metallic selenium not usable	To toning baths
Silver nitrate	$AgNO_3$	Nitric silver, lapis infernalis, argentum nitricum	Colourless crystals / Toxic! Caustic! store in brown glass-stoppered bottles	For intensifiers
Sodium acetate	CH_3COONa	Acetic acid sodium	Fine white needles	Buffer substance in hardening fixing baths
Sodium ammonium hydrogen phosphate	$Na(NH_4)HPO_4$	Ammonium sodium, phosphate, phosphoric salt, sodium ammonium phosphoricum	White crystals	For toning baths
Sodium, benzene sulphinic acid	$C_6H_5SO_2Na$	—	White leaves or needles	Component of various ORWOCOLOR processing solutions
Sodium carbonate	Na_2CO_3	Soda, carbonate of soda, natrium carbonicum	Crystalline: colourless crystals anhydrous: white powder	Developer alkali in paper processing in the bath after fixing
Sodium chloride	NaCl	Cooking salt, chlorosodium, natrium chloratum	White crystals	Additive to intensifier
Sodium hexametaphosphate	$Na_6(PO_3)_6$	M 19, calgon	White crystals	Water softener agent
Sodium hydrogen sulphite	$NaHSO_4$	Sodium bisulphate, acid sulphuric acid sodium, sodium hydrosulphate, sodium bisulphuricum	White crystals	For toning bath
Sodium hydrogen sulphite	$NaHSO_3$	Sodium bisulphite, acid sulphurous acid sodium, natrium bisulfurosum	White crystalline powder, sodium hydrogen sulphite, solution: yellowish liquid, smelling of sulphurous acid	As potassium disulphite
Sodium hydroxide	NaOH	Sodium hydroxide, quicksoda, caustic soda, sodium hydrate, natrium hydricum, natrium causticum; in solution: caustic soda solution, liquor natrii caustici	White compound in pieces, rods, plates or scales, deliquescent, to be stored bottles with rubber stopper Strongly caustic	Developer alkali for toning solution
Sodium sulphantimonate	Na_3SbS_4	Sodium thioantimonate, Schlippe's Salt, Sal Schlippii	Colourless to yellowish crystals	For toning baths

Designation/Formula		Other Designations	Appearance/Properties	Application
Sodium sulphate	Na_2SO_4	Sulphate of sodium, Glauber salt, natrium sulfuricum	Colourless crystals	For tropical developers and stop baths
Sodium sulphide	Na_2S	Natrium sulfuratum	Colourless crystals/deliquescent, unpleasant odour; to be stored well stoppered with rubber stoppers protected against light	For toning baths
Sodium sulphite	Na_2SO_3	Sulphurous sodium, natrium sulfurosum, sodium trioxosulphate, A 160	Crystalline: colourless crystals, quickly weathering. anhydrous white powder	Addition to developers
Sodium tetraborate	$Na_2B_4O_7$	Borax, borate of sodium, natrium biboracicum, di-sodium tetraborate	White salt	Developer alkali, addition to after-treatment solution
Sodium thiosulphate	$Na_2S_2O_3$	Sodium trioxothiosulphate, thiosulphate of sodium, fixing soda. Obsolete and wrong description: hyposulphurous sodium, sodium hyposulphite, hypo, soda	Crystalline: colourless crystals anhydrous: white powder	Main substance of all fixing baths additive to toning and stop baths
Spiritus, see alcohol		—	—	—
Spirits of salt	HCl	Hydrochloric acid, acidum hydrochloricum	Crude: yellowish liquid pure: colourless liquid concentrated, smokes in air, Caustic!	For cleaning tanks, dishes, etc.
Sublimate, see mercury chloride		—	—	—
Sulphuric acid	H_2SO_4	Oil of vitriol, acidum sulphuricum	Pure: colourless oily/on dilution, always add acid to water. Caustic, decomposes everything. Use with extreme care when undiluted	For fixing baths, reducers, reversal baths, and for cleaning of containers
Sulphuric acid urea, see thiourea		—	—	—
Sulphuric sodium, see sodium sulphide		—	—	—
Tetra-sodium diphosphate	$Na_4P_2O_7$	Pyrophosphoric sodium, sodium pyrophosphate	White powder	Component of various ORWOCOLOR processing solutions
Thiourea	$CS(NH_2)_2$	Sulphuric urea, sulphourea, thiocarbamide urea sulfurata	White crystals	For toning baths and reducers
Triphenyl phosphate	$(C_6H_5O)_3PO$	Phosphoric acid triphenylester	Pure white, in scales, phenolic odour	Component of adhesive
Uranyl nitrate	$UO_2(NO_3)_2$	Uranium nitrate, uranium nitricum	Yellow-green crystals/Toxic! Mark carefully and store separately	For intensifiers

Weights and Measures

Measures

1 Centimetre (cm) = 0.39 inch (in.)
1 inch = 2.54 centimetres

Liquid Measures

a) English

1 millilitre (ml) = 16.9 minims (min.) = 0.282 fluid drachms (dr. fl.)
1 fluid drachm = 60 minims = 3.55 millilitres
1 litre (l) = 35.3 fluid ounces (oz. fl.) = 0.22 gallon (gal.)
1 gallon = 160 fluid ounces = 4.546 litres

b) U. S. A.

1 millilitre (ml) = 16.2 minims (min.) = 0,27 U. S. dram (dr. fl.)
1 U. S. dram = 60 minims = 3.70 millilitres
1 litre (l) = 33.81 fluid ounces (oz. fl.) = 0.264 gallon (gal.)
1 gallon = 128 fluid ounces = 3.785 litres

Weights, Avoirdupois

1 gram (g) = 15.43 grains (gr) = 0.565 drachm (dr. av.)
1 drachm = 27.34 grains = 1.77 grams
1 kilogram (kg) = 35.27 ounces (oz. av.) = 2.205 pounds (lb. av.)
1 pound = 16 ounces = 0.4536 kilograms

Conversion Tables for Degrees of Temperature

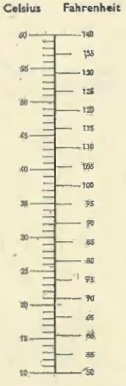
(Celsius = C., Fahrenheit = F.)

$$F = \frac{9C}{9} + 32$$

$$C = \frac{5(F - 32)}{5}$$

Frequently-used temperatures:

Fahrenheit	Celsius
212	100
122	50
100	37.78
77	25
68	20
65	18.3
59	15
32	0
0	–17.8



Application	Filter No.	Colour
1. Films and Plates		
a) For General Photography		
For universal room illumination when processing all ortho- and panchromatic emulsions, such as NO- and NP-films and plates	103	green
For work-space illumination when processing panchromatic material, for instance NP-films and plates	108	dark green mat
As work-space and room illumination for maximum speed non-sensitized as well as orthochromatic emulsions such as NO-films and plates	107	red
Two-part filter for alternate processing of ortho- and panchromatic material (only for illuminating work-space)	107/108	red/dark green mat
b) For Reproduction Technique		
FU 5 film and plate	113 D	yellow-green mat
For low-speed, unsensitized and orthochromatic emulsions, e. g. DF 1, FO 5	104	red-brown
For medium-speed, unsensitized and orthochromatic emulsions, e. g. FU 2, DK 1	107	red
For panchromatic emulsions, e. g. FP films and plates	108	dark green mat
Two-part filter for alternate processing of ortho- and panchromatic material (only as illumination of work-space)	107/108	red/dark green
For universal room illumination with simultaneous processing of orthochromatic and panchromatic material	103	green

Darkroom Lamp	Illumination	Wattage	Minimum distance from work-table in m
pyramid lamp	indirect	15	2.5
parabolic lamp	indirect	25	2.5
wall lamp	indirect	15	0.75
wall lamp	direct	15 to 25	0.75
pyramid lamp	direct	15	1.0
pyramid lamp	indirect	25 to 40	2.5
parabolic lamp	indirect	40 to 60	2.5
wall lamp with duplex equipment	direct	15 to 25	0.75
wall lamp	direct	15	0.75
wall lamp	direct	15	0.75
pyramid lamp	direct	15	1.0
pyramid lamp	indirect	25	2.5
parabolic lamp	indirect	40	2.5
wall lamp	direct	15 to 25	0.75
pyramid lamp	direct	15	1.0
pyramid lamp	indirect	25 to 40	2.5
parabolic lamp	indirect	40 to 60	2.5
wall lamp	indirect	15	0.75
pyramid lamp	indirect	25	2.5
wall lamp with duplex equipment	direct	15 to 25	0.75
pyramid lamp	indirect	15	2.5
parabolic lamp	indirect	25	2.5

Application	Filter No.	Colour
II. Papers		
a) For General Photography		
For contact papers as work-space and room illumination	112	light yellow mat
For universal room illumination when processing portraits and enlarging papers	113 D	yellow-green mat
For work-space illumination when processing portraits and enlarging papers	113 D	yellow-green mat
For alternate processing of contact and enlarging papers	112/113 D	light yellow mat yellow-green mat
b) For Technical Purposes		
For low-speed technical papers (work-space and room illumination)	104	red-brown
For higher-speed technical papers (work-space and room illumination)	107	red
For low-speed technical papers (work-space and room illumination)	113 D	yellow-green mat (dark)
III. X-ray Material		
For X-ray films, X-ray paper and materials of similar sensitivity (work-space illumination)	104	red-brown
Only for room illumination of the X-ray darkroom (film and paper processing)	118	light yellow-green mat
For X-ray films and material of similar speed (work-space illumination)	117	yellow-green mat
For X-ray screen film RS 2 (work-space and room illumination)	208	dark red

Darkroom Lamp	Illumination	Wattage	Minimum distance from work-table in m
wall lamp	direct	15	0.75
pyramid lamp	direct	15	1.0
pyramid lamp	indirect	25	2.5
parabolic lamp	indirect	40	2.5
pyramid lamp	indirect	25	2.5
parabolic lamp	indirect	40	2.5
wall lamp	direct	15	0.75
pyramid lamp	direct	15	1.0
wall lamp with duplex equipment	direct	15	0.75
wall lamp	direct	15	0.75
pyramid lamp	direct	15	1.0
pyramid lamp	indirect	25	2.5
parabolic lamp	indirect	40	2.5
wall lamp	direct	15 to 25	0.75
pyramid lamp	direct	15	1.0
pyramid lamp	indirect	25 to 40	2.5
parabolic lamp	indirect	40 to 60	2.5
wall lamp	direct	15	0.75
pyramid lamp	direct	15	1.0
wall lamp	direct	15	0.75
pyramid lamp	direct	15	1.0
pyramid lamp	indirect	15	2.5
parabolic lamp	indirect	25	2.5
wall lamp	direct	15	0.75
pyramid lamp	direct	15	1.0
wall lamp	direct	15	0.75
pyramid lamp	indirect	40	2.5

Application	Filter No.	Colour
IV. Infrared Material		
For infrared film NI 750, infrared plate I 750	108	dark green mat
For infrared plate I 850	108	dark green mat
For infrared plates, I 850, I 950, and I 1050	114	yellow-brown
V. ORWOCOLOR Material		
Universal room illumination with ORWOCOLOR negative and ORWOCOLOR reversal film	170	dark green
Work-space illumination for ORWOCOLOR negative and ORWOCOLOR reversal film	170	dark green
Universal room illumination with ORWOCOLOR positive film/ ORWOCOLOR Dup. Film DC 1 and ORWOCOLOR paper	164 165 166	greenish-yellow greenish-yellow greenish-yellow
Work-space illumination with ORWOCOLOR positive film/ ORWOCOLOR Dup. Film DC 1 and ORWOCOLOR paper	166	greenish-yellow

Darkroom Lamp	Illumination	Wattage	Minimum distance from work-table in m
wall lamp	direct	15	0.75
wall lamp	indirect	15	0,75
wall lamp	indirect	glow lamp*	0.75
pyramid lamp	direct	40	2.0
wall lamp	indirect	15	0.75
pyramid lamp	direct	glow lamp*	2.0
pyramid lamp	direct	sodium-vapour lamp	2.0
pyramid lamp	direct	40	2.0
wall lamp	direct	15	0.75

* For example, beehive glow lamps of typ BK 60 of VEB (K) Glüh- und Glimmlampenwerk, Cursdorf, Thüringer Wald.

Code of Photochemicals ORWO/ORWOCOLOR

A. In alpha-numeric Sequence:

A 30 (R)	X-ray developer (regenerator)	
A 32 (R)	Special x-ray developer (regenerator)	
A 35	x-ray surgical developer	
A 49 (R)	finest-grain developer (regenerator)	
A 71	reproduction developer	
A 77	reproduction developer, adjustable	
A 82	special reproduction developer	
A 140	developer substance (1-hydroxy-2.4-diaminobenzene)	
A 300	fixing salt, acid	
A 302	hardening additive for fixing baths	
A 304	rapid fixing salt	
A 309	x-ray hardening fixing bath	
A 310	x-ray fixing salt, acid	
A 314	x-ray rapid fixing salt	
A 605	copper intensifier	
A 700	reducer (after Farmer)	
A 826 (R)	first developer (regenerator)	for black-and-white reversal film
A 830	reversal bath	for black-and-white reversal film
A 831	clearing bath	for black-and-white reversal film
A 841	second developer	for black-and-white reversal film
A 850	fixing bath	
A 901	anti-lime agent	
A 902	tank balls	
A 960	substandard film cement	
A 961	substandard film cement	
A 962	cement for cine-safety films	
A 970	cement for magnetic tape	
A 980	reproduction film adhesive varnish	
B 104	special paper developer	
C 09 (R)	first developer for ORWOCOLOR reversal film (regenerator)	
C 13 R	colour developer for ORWOCOLOR film (regenerator)	
C 35	stop-hardening fixing bath for ORWOCOLOR positive film and paper	
C 57	bleaching bath for ORWOCOLOR film	
C 71	fixing bath for ORWOCOLOR film	
C 75	hardening fixing bath for ORWOCOLOR reversal film	

C 112 (R)	colour developer for ORWOCOLOR paper (regenerator)
C 152	bleaching bath for ORWOCOLOR paper
C 176	fixing bath for ORWOCOLOR paper
C 184	hardening bath for ORWOCOLOR paper
C 203	light-protective agent for ORWOCOLOR paper
D 51	Bright light developer
D 903	desensitizer
E 102	universal developer solution
F 43 (R)	fine-grain developer (regenerator)
F 905	wetting agent
G 04	developer solution (para-hydroxy phenylglycin)
G 141	developer substance (para-hydroxy phenylglycin)
H 02	special negative developer
H 142	developer substance (hydroquinone)
M 143	developer substance (monomethyl-p-aminophenol sulphate)
M-H 28	developer solution
N 103	paper developer
N 904	retouching dyestuff
R 09	developer solution (paraminophenol)

B. According to application groups

Black-and-White (general)

Developers

A 49 (R)	finest-grain developer (regenerator)
D 51	bright-light developer
F 43 (R)	fine-grain developer (regenerator)
G 04	developer solution
H 02	special negative developer
R 09	developer solution
M-H 28	developer solution
B 104	special paper developer
E 102	universal developer solution
N 103	paper developer

Developer Substances

A 140	1-hydroxy-2.4-diaminobenzine
G 141	para-hydroxyphenylglycin
H 142	hydroquinone
M 143	monomethyl-p-aminophenol sulphate

Fixing Salts

A 300	fixing salt, acid
A 302	hardening additive for fixing baths
A 304	rapid fixing salt

Special baths

A 605	copper intensifier
A 700	reducer (after Farmer)

Auxiliary means

A 901	water softener
A 902	tank balls
D 903	desensitizer
N 904	retouching dyestuff
F 905	wetting agent
A 960	substandard film cement
A 961	substandard film cement
A 962	cement for cine-safety film
A 970	cement for magnetic tape
A 980	reproduction-film adhesive varnish

Black-and-White (Special Processes)

Reversal

A 826 (R)	first developer (regenerator)
A 830	reversal bath
A 831	clearing bath
A 841	second developer
A 850	fixing bath

Reproduction

A 71	reproduction developer
A 77	reproduction developer, adjustable
A 82	special reproduction developer

X-Ray

A 30 (R)	x-ray developer (regenerator)
A 32 (R)	special x-ray developer (regenerator)
A 35	x-ray surgical developer
A 309	x-ray hardening fixing bath
A 310	x-ray fixing salt, acid
A 314	x-ray rapid fixing salt

ORWOCOLOR

C 09 (R)	first developer (regenerator)	For ORWOCOLOR Films
C 13 (R)	colour developer (regenerator)	
C 35	stop-hardening fixing bath	
C 57	bleaching bath	
C 71	fixing bath	
C 75	hardening fixing bath	
C 112 (R)	colour developer (regenerator)	For ORWOCOLOR Paper
C 35	stop-hardening fixing bath	
C 152	bleaching bath	
C 176	fixing bath	
C 184	hardening bath	
C 203	light-protective agent	

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